June 1954

MECHANICAL ENGINEERING

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ASME Semi-Annual Meeting, Pittsburgh, Pa., June 20-24, 1954

THE MOST IMPORTANT LINE IN AMERICA

It's America's lifeline, really – the power line that starts with steam and brings heat, light, and energy to the nation's factories, farms, homes, and stores. Paralleling that line is the line of cost; if that didn't go down, the power line might.

Power costs have declined steadily since 1881, when Thomas A. Edison opened the nation's first electric generating station and B&W, who supplied his boilers, embarked on a fruitful, continuing search for better and better ways to generate steam and to harness more and more usable energy from the fuel consumed.

Economical, dependable service is the watchword of America's Electric Companies. The chart reflects how well their all-important job is being done. And to help insure that electricity will remain America's best bargain, B&W Research and Engineering dedicates men, money and machines to continuing progress in steam and fuel technology.

Light's Diamond Jubilee
Light for Freedom – Power for Progress

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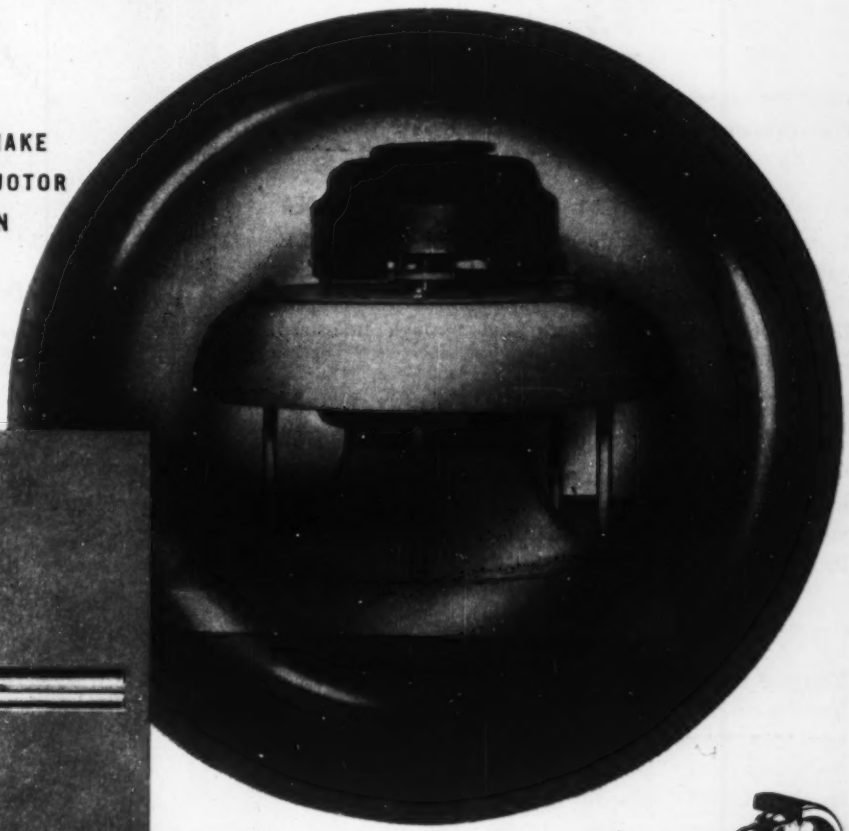
BOILER DIVISION

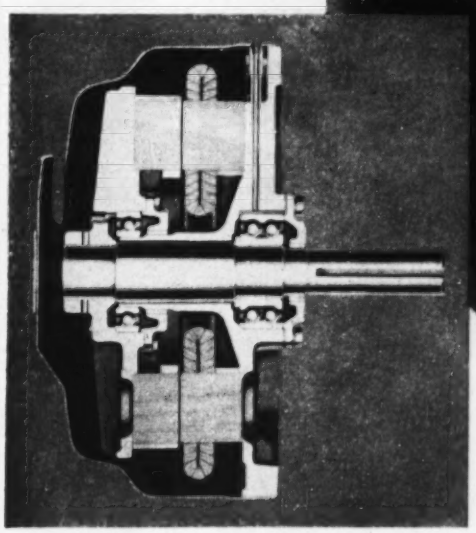
N-183

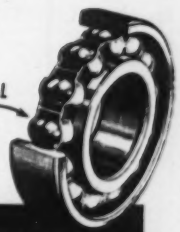
BALL BEARINGS BEST...

...for Space-Saving, Streamlined Designs!

NEW DEPARTURES HELP MAKE THIS FAIRBANKS-MORSE MOTOR A MASTERPIECE IN DESIGN







New Departure's angular-contact, preloaded double-row **ball** bearing gives maximum resistance to deflection under *all* load conditions. In the Fairbanks-Morse axial air-gap motor, this bearing assures rigid, permanently accurate support for the rotor. The air gap is maintained with uniformity under *all loads and mounting positions.* Adjustments are never needed—and that means peak motor efficiency *at all times.*

Remember—New Departure is always ready to help with your bearing problems. Talk with your New Departure engineer *now!*

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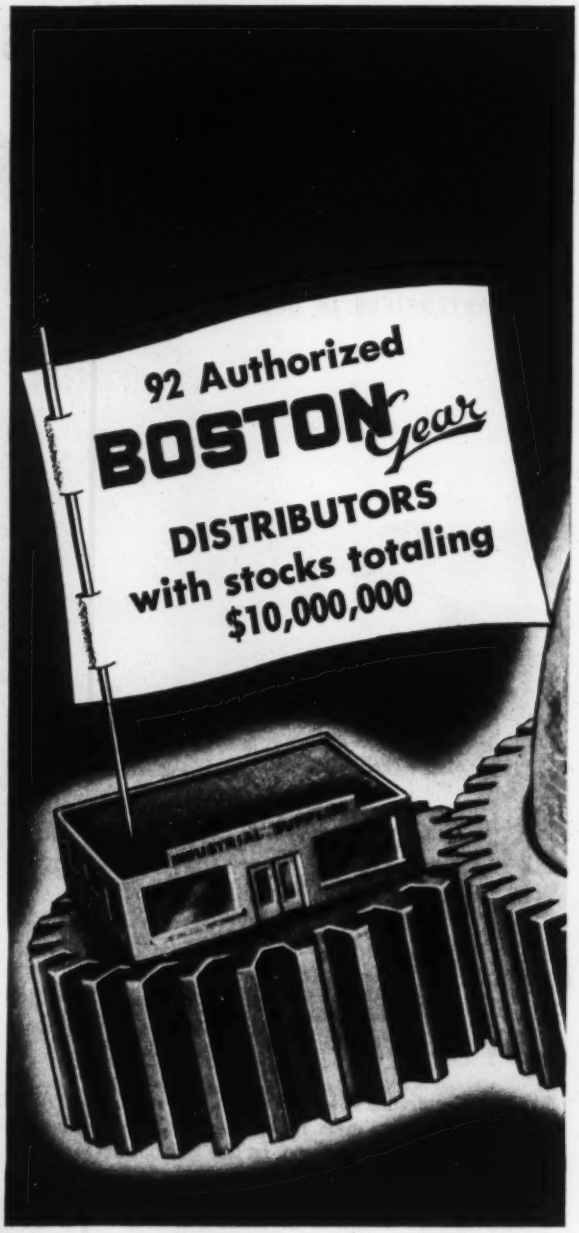

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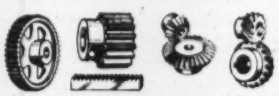

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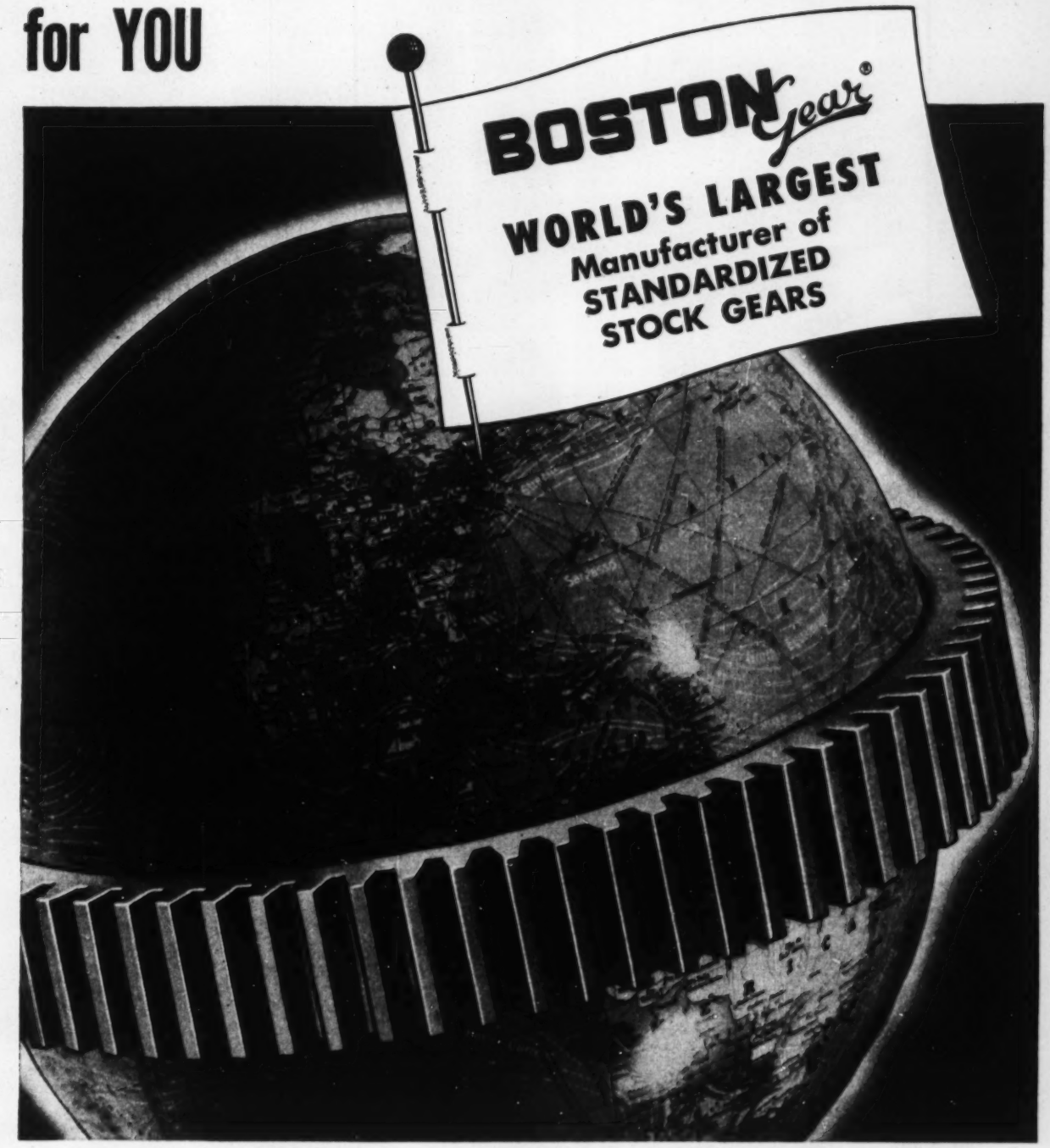

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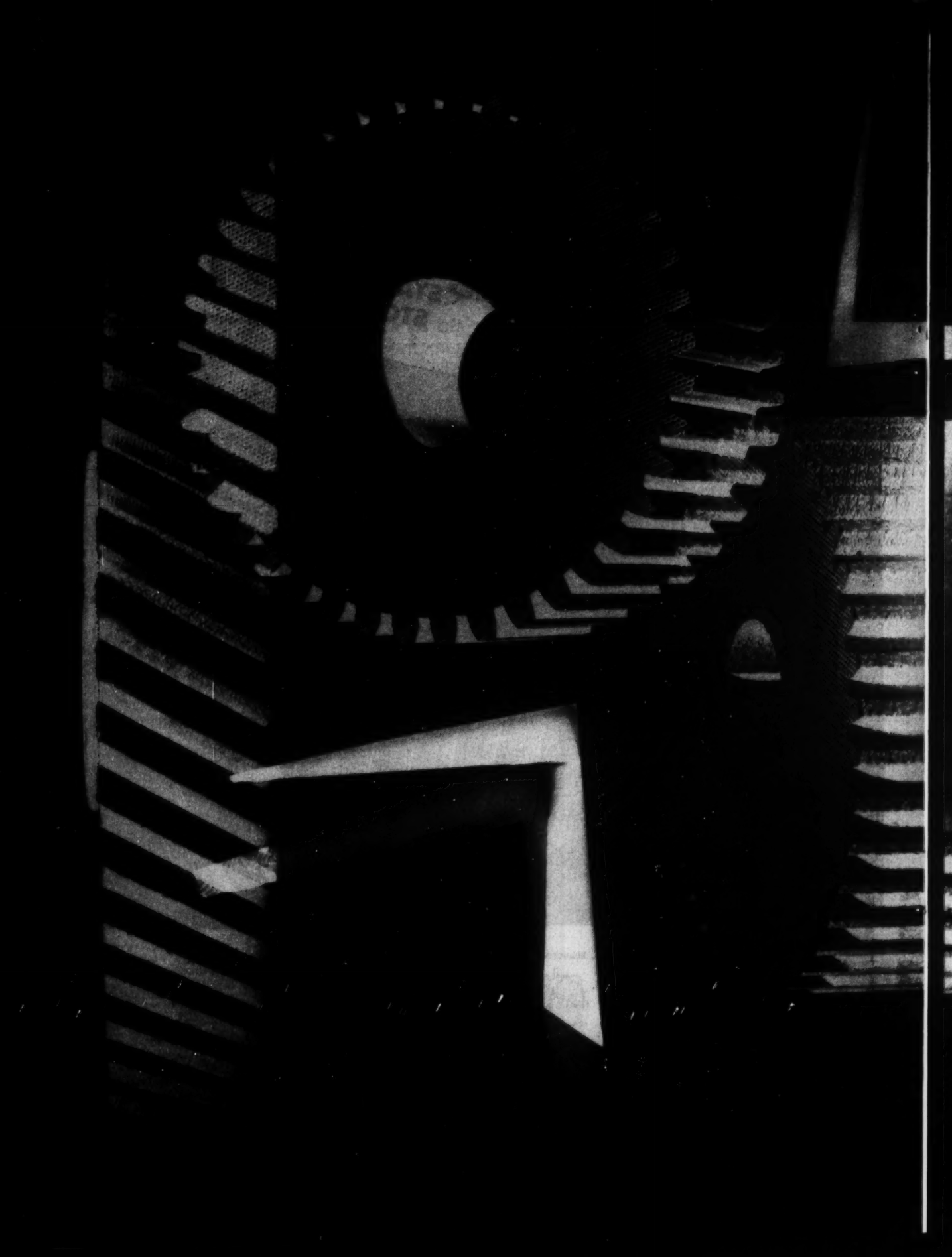

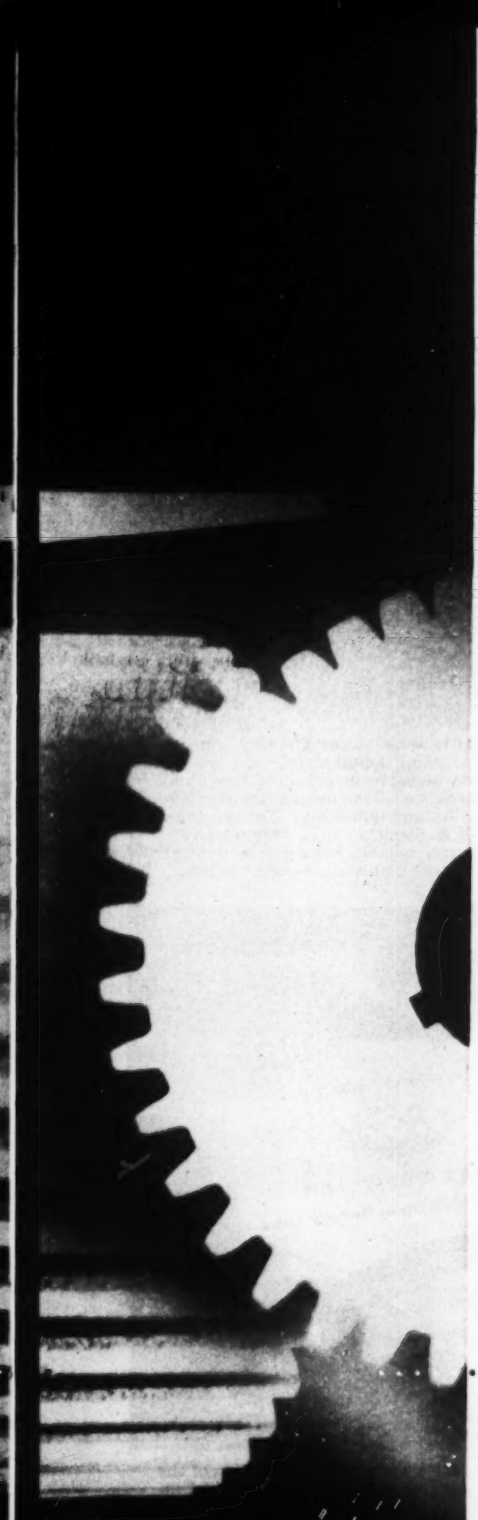

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ME-6-54

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SENSITIVE... *but only to heat*

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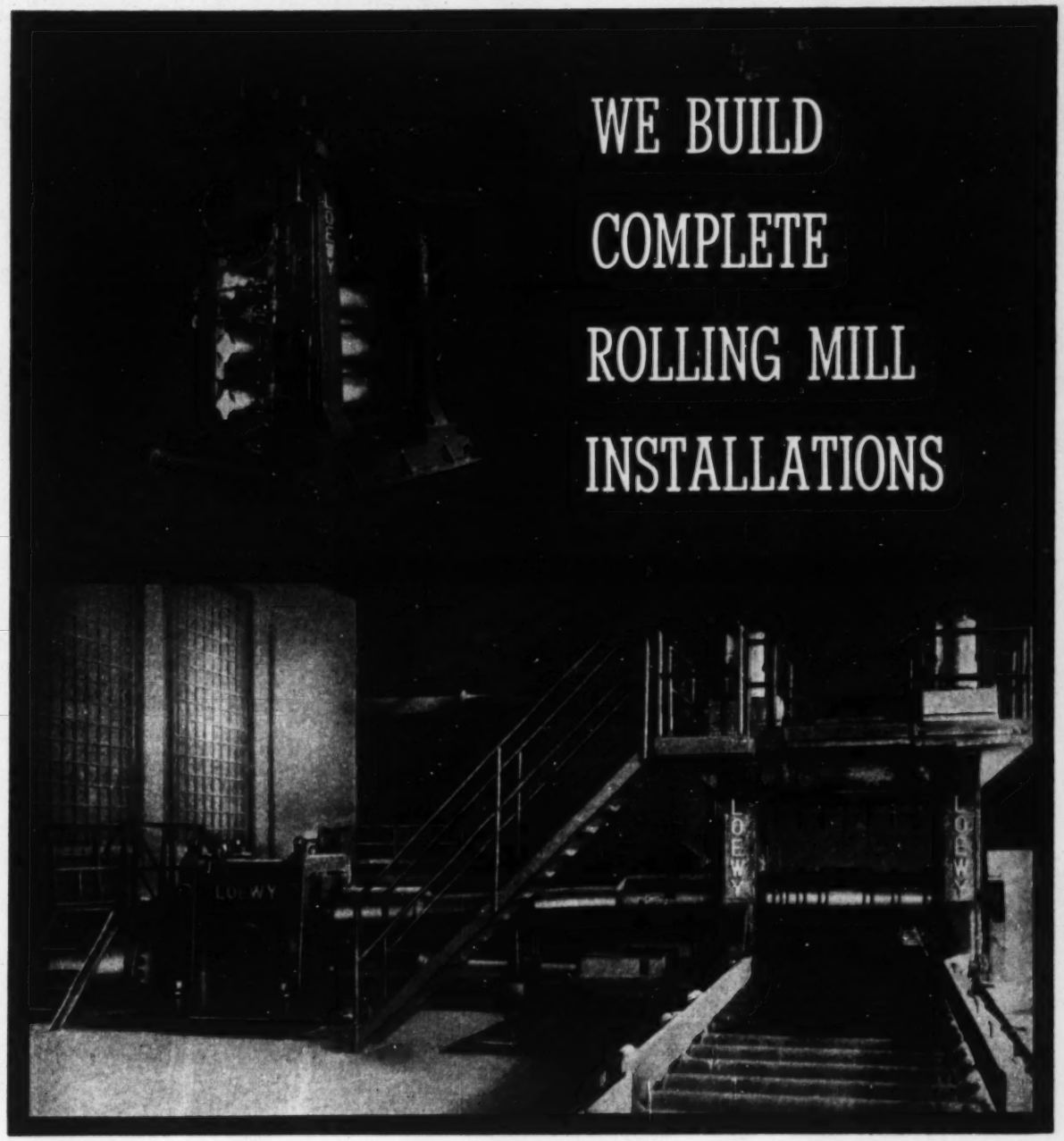

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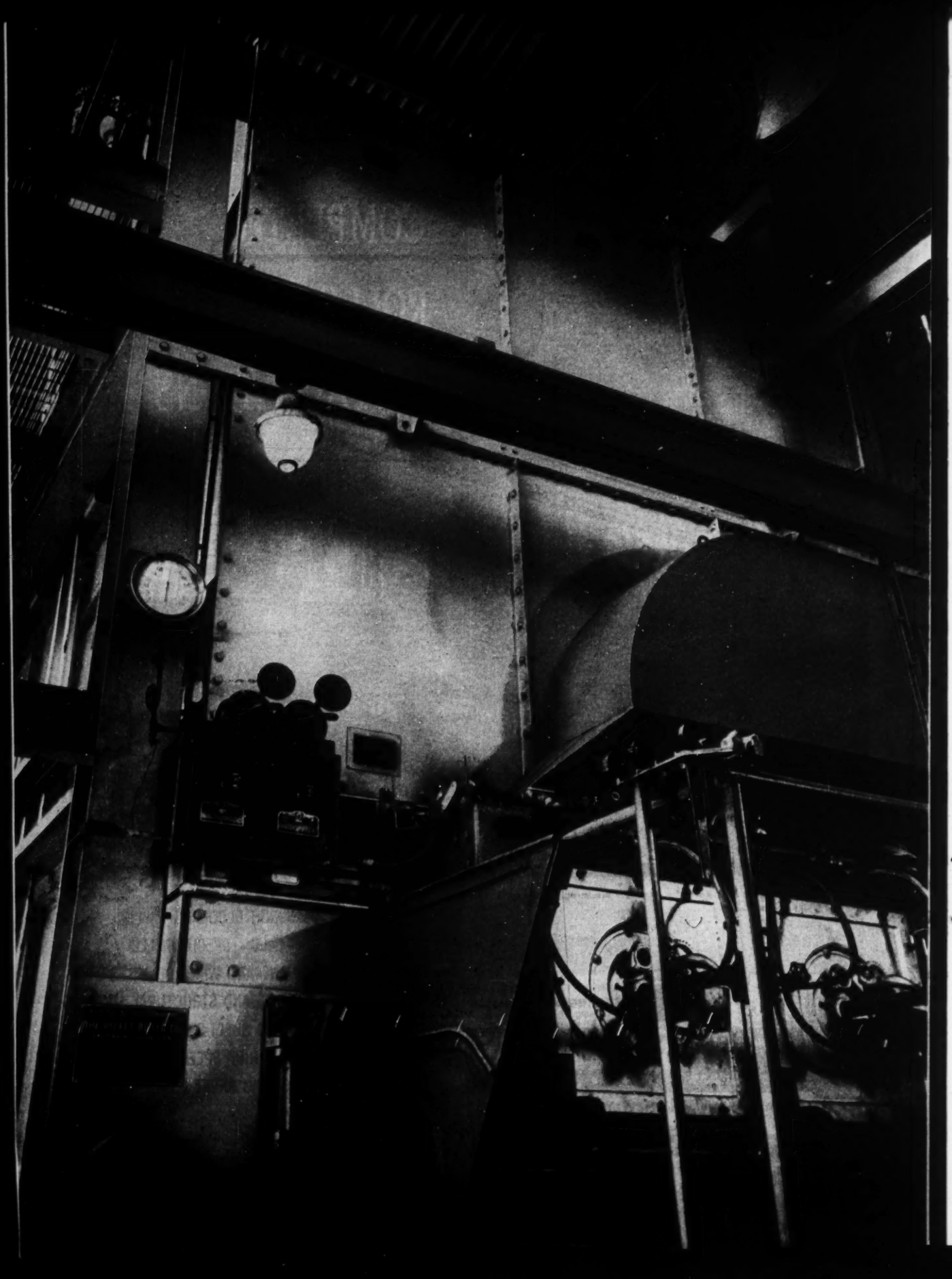

WICKES

3-drum boiler at KEELER BRASS COMPANY

Installation of a new 3-drum WICKES Water Tube Steam Generator has substantially increased operating efficiency at the Keeler Brass Company, Grand Rapids, Michigan, the world's largest manufacturer of furniture hardware. The new boiler, a combination oil-fired and underfeeder stoker unit, is capable of producing 40,000 lbs. of steam per hour at 350 psi.

WICKES will design and build water tube steam generators for any practical size and pressure. WICKES also offers a wide choice of auxiliary equipment so that it's possible for you to get not only the best steam generator, but also the best correlated equipment. Contact your nearest WICKES sales representative or write us today.

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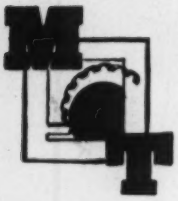


This symbol identifies the National Machine Tool Builders' Association—a group of 196 manufacturers of machine tools. 148 of these companies, or 3 out of 4, are using Garlock KLOZURE Oil Seals.

3 out of 4 Machine Tool Builders use KLOZURE* OIL SEALS

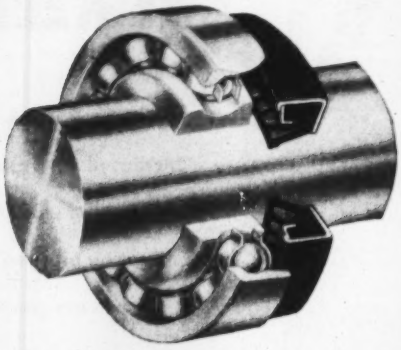
Here are 3 reasons why–

1. The KLOZURE Oil Seal is a precision-made product, so necessary for all components of the tools which are designed for fine precision machining.

2. KLOZURES are *uniform*—both in sealing contact and in spring load.

3. KLOZURE Oil Seals are extremely *efficient*—they provide effective sealing with a minimum of power loss and heat generation.

For positive bearing protection specify KLOZURE Oil Seals for your machinery. KLOZURES are made in many models and a complete range of sizes. Get all the facts—call your Garlock representative or write for KLOZURE Catalog No. 10.



Model 53 finger spring KLOZURE, for normal and high speed service, applied to a shaft to protect the ball bearing.

Model 51 — A general purpose finger spring seal for medium speeds.

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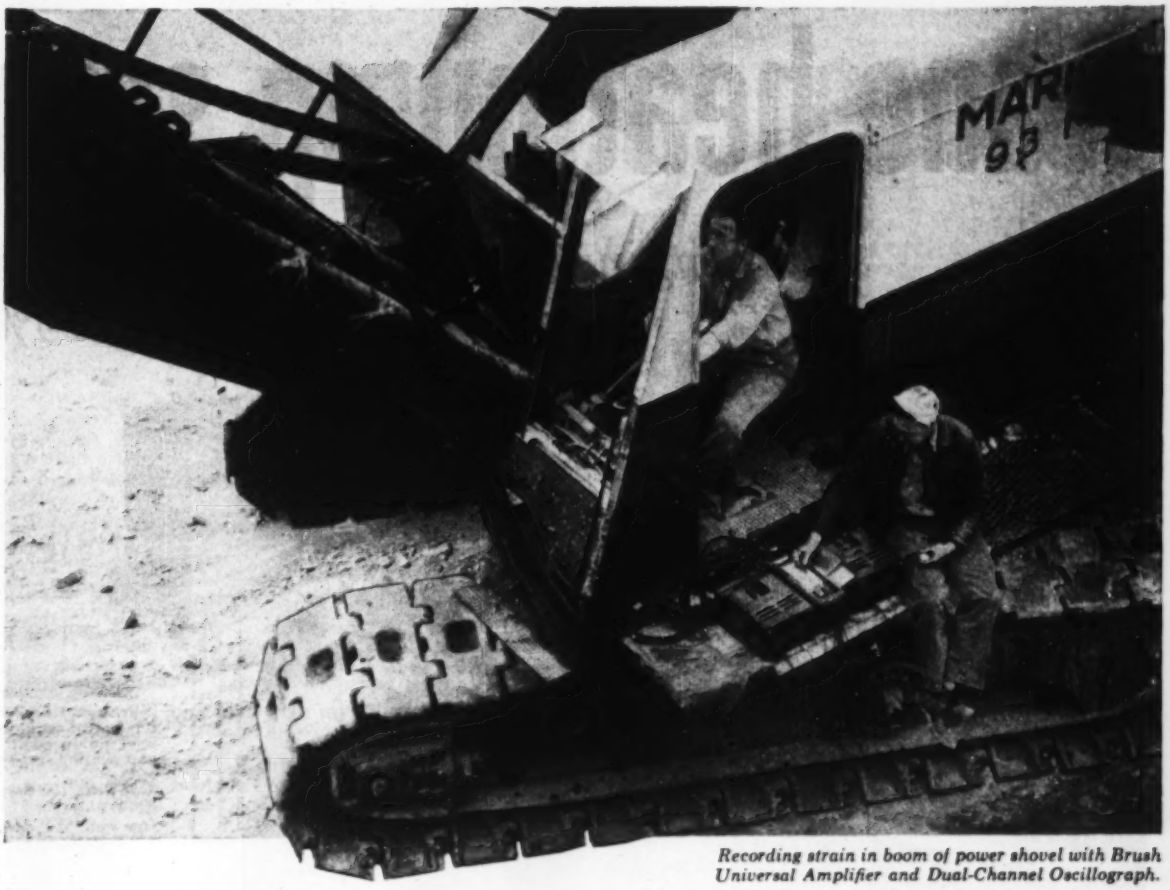

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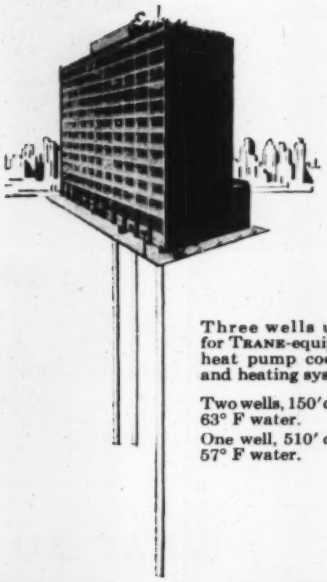
Trane heat pump sets

Engineers of Portland's 12-story provides heat for only 16%



Three wells used for TRANE-equipped heat pump cooling and heating system.

Two wells, 150′ deep, 63° F water.

One well, 510′ deep, 57° F water.

Trane ConTraVac, refrigeration compressor from 50 to 400 tons, is ideal for heat pump or standard cooling jobs. *Cuts power* costs, automatically adjusts to load from 10% to 100% capacity. *Saves labor*—no attendant needed. *Simplifies installation*—no special base or sound-proofing required.

one source

new economy record!

Equitable building report heat pump of district steam costs!

- If district steam had been used for heating, total year-'round *heating-cooling* costs would have been *64% greater.*
- A total of 37% of the entire heating need was met with "*by-product*" heat —heat salvaged from the cooling process during those periods when heating and cooling were both required.
- Combined heating and cooling costs were 11.3 cents per sq. ft. (*less than half* the average for air conditioned office buildings in the U.S.)

These are findings reported by the installation's designer, J. Donald Kroeker, consulting engineer—as taken from a recent report to the A.S.H.V.E. and published in the November, 1953, issue of Heating, Piping & Air Conditioning.

This outstanding economy record was set by a 540-ton year-'round heat pump. A complete TRANE installation, including 4 hermetic centrifugal compressors, fans, coils and circulators.

The installation fully exploits Portland's low electrical rates, availability of well water at two temperatures from 57° to 65°, relatively mild climate and other favorable factors. While these conditions are not generally so favorable in most areas, your investigation of the heat pump for year-'round air conditioning may save thousands of dollars per year.

The New Trane CenTraVac— heart of an efficient heat pump installation

Fundamental to a low-cost operation in any heat pump installation is the system's ability to closely match power input to widely varying load conditions. The new TRANE CenTraVac (current model of the TRANE Centrifugal Compressors used in the Equitable job) has automatic, *continuously-variable* capacity control from 10% to 100%. This limits power use to the load requirement for outstanding economy.

Completely automatic CenTraVac permits unattended operation

The fully automatic design of the TRANE CenTraVac leaves the system supervisor free for other duties. The only *hermetic* centrifugal refrigeration unit on the market, its exclusive design eliminates shaft seals . . . frequent cause of breakdowns. Direct drive eliminates noisy, power-wasting gear boxes.

One source — One responsibility

The complete TRANE line of matched cooling-heating products simplifies design, procurement, follow-through. You have *one* source, *one* responsibility, and the ready cooperation of the largest group of technically-trained sales engineers in the industry.

See your TRANE Sales Office or write TRANE, La Crosse, Wis. Just ask for CenTraVac Bulletin DS-399.

Trane Unit Air Conditioners For Any Need

Climate Changers heat, cool, humidify, dehumidify, filter air. Multi-zone models provide up to 6 (or more) zones with different climates at the same time.

UniTrane room air conditioners give more year-'round comfort air conditioning for less money. Save space. Can save cost of central ventilation system.

...one responsibility TRANE

MANUFACTURING ENGINEERS OF AIR CONDITIONING, HEATING AND VENTILATING EQUIPMENT

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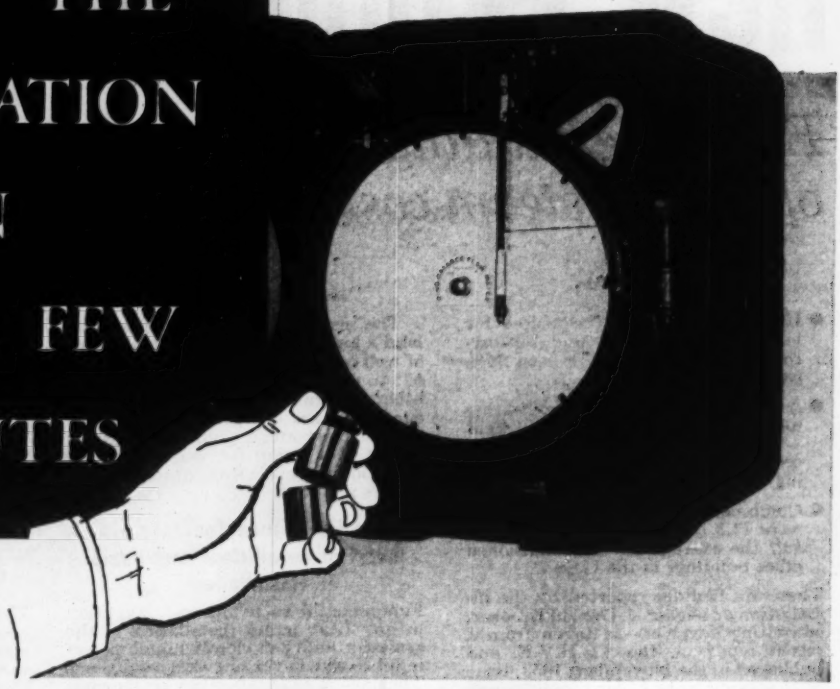
CHECK THE CALIBRATION IN JUST A FEW MINUTES



A routine check of the calibration of any Hagan Ring Balance Meter takes just a few minutes. One man can make the check, and he only needs the calibrated dead weights furnished with the meter.

The check can be made with the measuring element under full static pressure, and without requiring a manometer or other cumbersome testing equipment.

The procedure is simple. Equalize the meter, hang calibrated weights on the ring element, and compare the pen arm position with the total dead weight used.

The ease and simplicity of the dead weight method makes meter checking an easy operation, instead of a real chore.

The Hagan Ring Balance Meter design includes many other advantages, such as these:

- No stuffing boxes or pressure-tight bearings to leak or to add friction.
- Mercury level is not critical.
- Full scale differential with any ring is adjustable over 7:1 range.
- Sensing elements are interchangeable for full scale differentials from 1″ to 420″ WC.
- Pneumatic or electric signal transmitters are available for remote recording or for automatic control purposes.
- Simple automatic compensation for such factors as fluid density, pressure or temperature is a standard attachment.
- Two rings, measuring separate quantities, can be mounted in a single meter housing. Individual measurements can be recorded separately, as well as added or subtracted.

We will be glad to suggest the metering equipment best suited for improving an existing installation, or for extensions and new construction.

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CLEAVER-BROOKS modern CB boiler

NO BOILER HAS EVER OFFERED SO MANY ADVANTAGES AND QUALITY FEATURES AT SUCH LOW INITIAL COST

• This NEW CB boiler has EVERYTHING needed to bring *big boiler standards* to commercial, industrial and institutional users with small capacity requirements. Despite its unusual, compact size you get big boiler performance — from matched-quality components, proved the world over on thousands of Cleaver-Brooks self-contained units.

Get all the facts NOW on how the new CB can help you save dollars. Make it a point to see . . . and *hear* the most silent-running, biggest boiler value available anywhere!

•

gives you all the quality features of time-tested self-contained design

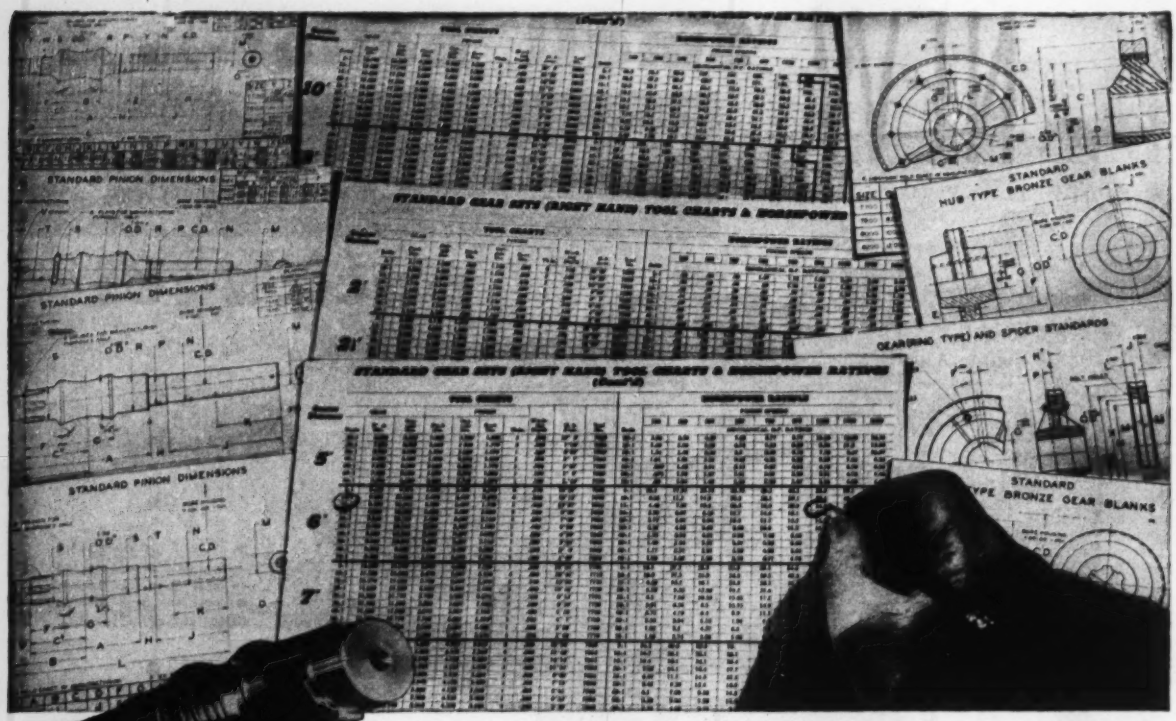
- **FOUR-PASS FIRETUBE CONSTRUCTION** — longer gas travel scrubs heat from flame — means lower fuel costs — guaranteed efficiency of 80% when firing with oil.
- **SILENT OPERATION** — even at peak load this boiler more than meets the low sound levels required for schools, hospitals, institutions.
- **FULL FIVE SQUARE FEET** — of heating surface per boiler hp — for longer service life and low maintenance.
- **FUEL FLEXIBILITY** — burns available light oil, gas, or combination oil/gas — simple, quick fuel changeover on oil/gas models.
- **FAST, EASY MAINTENANCE** — front and rear doors hinged for fast inspection, cleaning or servicing boiler.
- **AUTOMATIC SAFE OPERATION** — all controls centralized and conveniently located — modern electronic combustion control is standard equipment.
- **COOLER BOILER ROOM** — fiber glass blanket insulation and 16 gauge metal sectional lagging are non-corrosive, moisture and heat resistant.
- **FULLY APPROVED** — by Underwriter Laboratories; conforms to ASME codes; factory tested before shipment.

Call your nearest CB boiler representative (see your phone directory) or send for this illustrated catalog describing the NEW CB — designed by Cleaver-Brooks, originators of self-contained boilers.

Cleaver Brooks

Cleaver-Brooks Company, Dept. G. 319 E. Keefe Ave., Milwaukee 12, Wisconsin, U.S.A.
Cable Address: CLEBRO — Milwaukee — All Codes.

Originators of the Self-Contained Boiler



Specify STANDARD Cone-Drive Gears and get all these advantages

Lower Cost—due to smaller size of gears and housings, mass production of worm and gear blanks, etc.

Compactness—due to distribution of load over greater contact area, reducing unit pressures. As a result, gear sets can have smaller center distances, enclosures can be smaller, etc.

Less Weight—due to smaller center distances for a given horsepower or torque. Other types of gearing weigh up to 3 times as much for the same horsepower transmitted.

Greater Smoothness—because Cone-Drive gears have more teeth in continuous contact than other forms of gearing.

Wide Range of Sizes—Center distances from 2" to 18" provide horsepower ratings from fractional up to 800 horsepower. Ratios range from 5/1 to 70/1.

***plus* this vital feature**

Standard *Cone-Drive gears and worms are carried in stock. Cone-Drive gears are noted for their long life—BUT if a failure should occur at any time, replacement gears and worms are available without delay.*

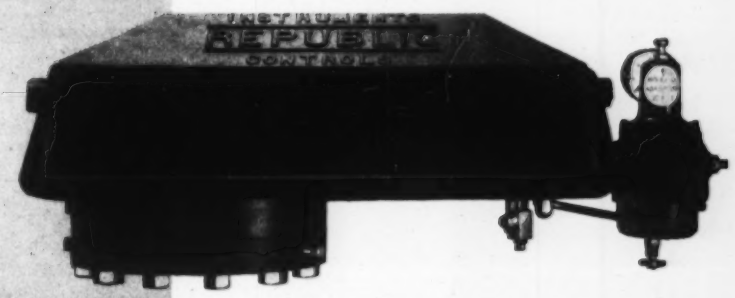
Ask for Catalog No. 700

CONE-DRIVE GEARS
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
Division, Michigan Tool Company
7171 E. McNichols Road • Detroit 12, Michigan

COMBINES MACHINE RUGGEDNESS WITH INSTRUMENT PRECISION for dependable low maintenance metering

REPUBLIC

pneumatic transmitter for measuring FLOW, PRESSURE, LEVEL or DENSITY...



Machine dependability with instrument accuracy and sensitivity! Think what this combination of features can mean in your plant—less maintenance, longer life for lowest "long run" cost, *continuous* accurate operation.

You get all of these benefits and more with the Republic Pneumatic Transmitter. Force-balance operation permits the use of strong rugged parts with no sacrifice in accuracy or sensitivity. Gives exceptional overrange protection.

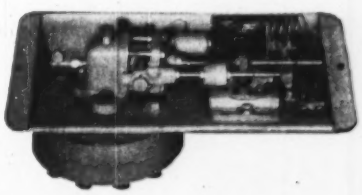
Housed in a durable metal case, the transmitter may be adjusted for mounting at any angle, indoors or out. Its accuracy is not affected by changes in ambient temperature vibration, normal changes in supply air pressure or inaccurate leveling. Uses no mercury or purge pots. Can be used with very viscous fluids.

The Republic transmitter isolates fluids to a measuring chamber which may be supplied in a variety of corrosion resistant materials. It sends an air pressure proportional to fluid flow, pressure, level or density to reading instruments or for actuation of an automatic controller.

Republic Pneumatic Transmitters are proving their superiority in hundreds of chemical and oil field applications. Investigate their advantages for you — write for your free copy of 36 page Data Book No. 1004.

SPECIFICATIONS:

ACCURACY — ½% of maximum range guaranteed for standard models.
DIFFERENTIAL RANGES — Any desired span between 0-0.6" H_2O and 0-750 psi at operating pressures of 15 psig to 2000 psig.
PRESSURE RANGES — Any desired span between 0-1" H_2O and 0-2000 psig.
LEVEL RANGES — to meet almost any application.
DENSITY RANGES — 0.15 sp. gravity spread for 3 to 15 psig output pressure from any base density.
Extremely wide range change is possible without change of parts. Ranges may be easily changed, suppressed, compounded or reversed.



● ***EASILY SERVICED*** Cover can be completely removed for access to all range adjustments and replaceable parts. No special tools required.

REPUBLIC FLOW METERS CO.
2240 Diversey Parkway, Chicago 47, Illinois

Depend on LADISH

To Meet All Your Fittings Needs With an Unsurpassed Range of Sizes and Materials

1 BUTT WELDING FITTINGS

2 A.S.A. FORGED FLANGES

3 FORGED SCREWED OR SOCKET WELDING FITTINGS

4 T.E.M.A. HUB & RING FLANGES

5 LONG WELDING NECKS

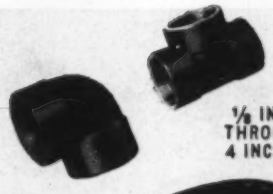
6 LARGE DIAMETER FLANGES AND RINGS

Available in...

Complete Service . . .

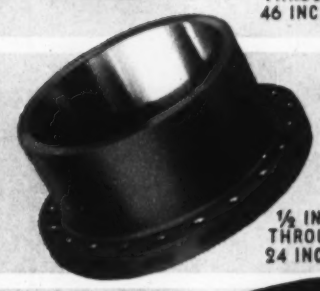
⅛ INCH THROUGH 42 INCHES

½ INCH THROUGH 24 INCHES



⅛ INCH THROUGH 4 INCHES

6 INCHES THROUGH 46 INCHES



½ INCH THROUGH 24 INCHES

UP THROUGH 20 FEET O.D.

CARBON, STAINLESS AND ALLOY STEELS, ALUMINUM, NICKEL AND OTHER FERROUS AND NON-FERROUS METALS

To Meet Your Entire Fittings Needs with a Line Complete In All 6 Major Types

For dependable service that results from an ideal combination of broad line and ample stock . . . specify and buy LADISH . . . the Controlled Quality line that offers a complete range of sizes, types, weights, pressure ratings and materials needed for virtually any piping installation. Your local Ladish distributor's ample stock is backed by complete factory inventories to keep your piping jobs on schedule. So, for *complete service* in fittings . . . specify and buy LADISH.

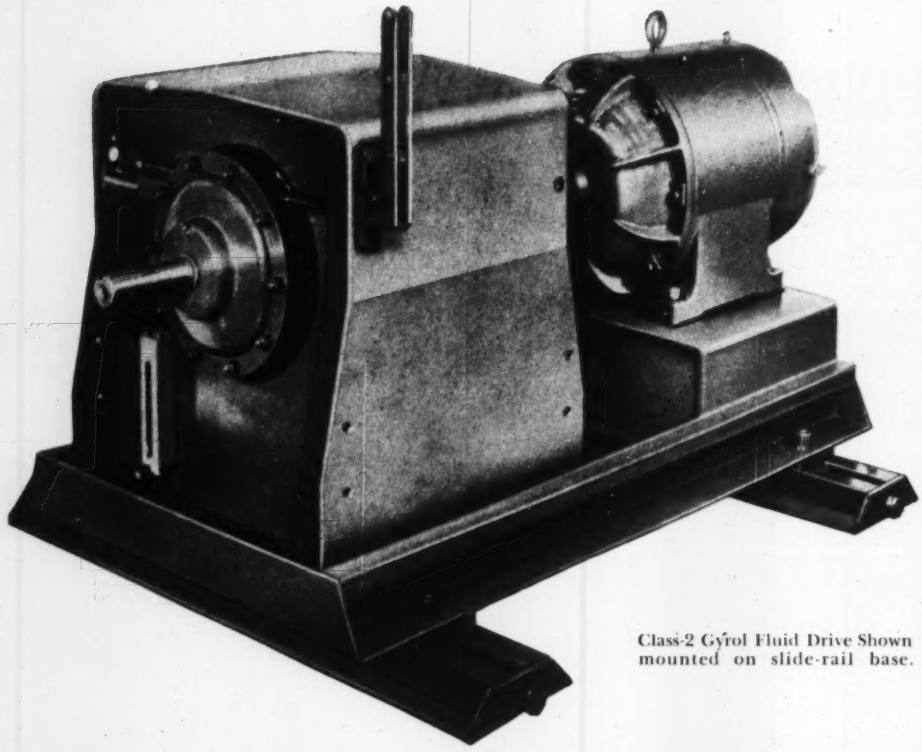
For your new 304-page Ladish Fittings Catalog, No. 55 contact your Authorized Ladish Distributor, your local Ladish District Office, or write to Ladish Co., Dept. ME, Cudahy, Wis.

THE COMPLETE *Controlled Quality* FITTINGS LINE
PRODUCED TO ONE STANDARD OF UNSURPASSED QUALITY

LADISH CO.

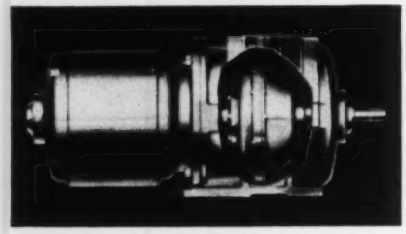
CUDAHY, WISCONSIN
MILWAUKEE SUBURB

District Offices: New York • Buffalo • Pittsburgh • Philadelphia • Cleveland • Chicago • St. Paul • St. Louis • Atlanta • Houston • Tulsa • Los Angeles • San Francisco • Havana • Mexico City • Brantford, Ont.



Class-2 Gyrol Fluid Drive Shown mounted on slide-rail base.

New Gyrol fluid drive offers dual rotation,* adjustable speed



For smaller applications—American Blower TM Constant-Speed Gyrol Fluid Drive. Available in ratings from 1 to 20 hp.

Get the facts today!

Write to: American Blower Corporation, Dept. 180-6, Detroit 32, Michigan. Ask for a copy of Bulletins 9419 and 9519. They will be sent to you promptly along with any other information you may require.

Look at all these features

- *Can be reversed while in motion by reversing motor
- Trigger-action response—adjustable speed
- Speed range 5-1
- Permits across-the-line starting on many applications
- Motor can reach full speed before engaging load
- A compact, self-contained unit
- Speed may be controlled manually or automatically
- Six sizes, 7½ thru 800 hp — speeds up to 1800 rpm

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN • CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

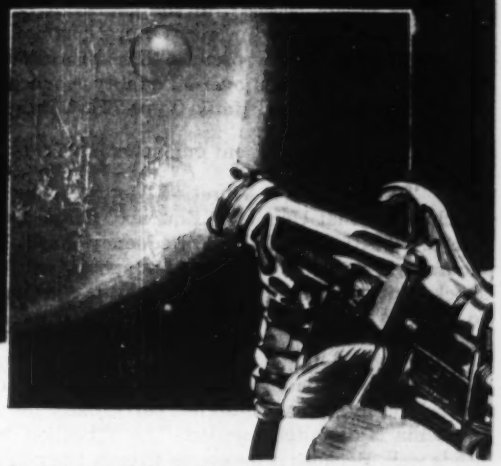
STOP RUST!

with

RUST-OLEUM®

Beautify As You Protect

Simply brush Rust-Oleum 769 Damp-Proof Red Primer directly over the rusted surface after scraping and wire-brushing to remove rust scale and loose rust. Rust-Oleum's specially-processed fish oil vehicle penetrates rust to bare metal—saving time, money, and metal! Then—beautify as you protect with Rust-Oleum's brilliant array of finish coatings. Specify Rust-Oleum for new construction, maintenance, and re-modeling. See Sweet's for complete catalog and nearest Rust-Oleum Industrial Distributor, or clip coupon to your letterhead . . . and mail today.



ABOVE: Applying Rust-Oleum 769 Damp-Proof Red Primer Over Rusted Surface After Scraping and Wire-Brushing to Remove Rust Scale and Loose Rust.

AT RIGHT: Applying Rust-Oleum Gray (One of Many Rust-Oleum Colors for Rust Prevention and Decorative Beauty).

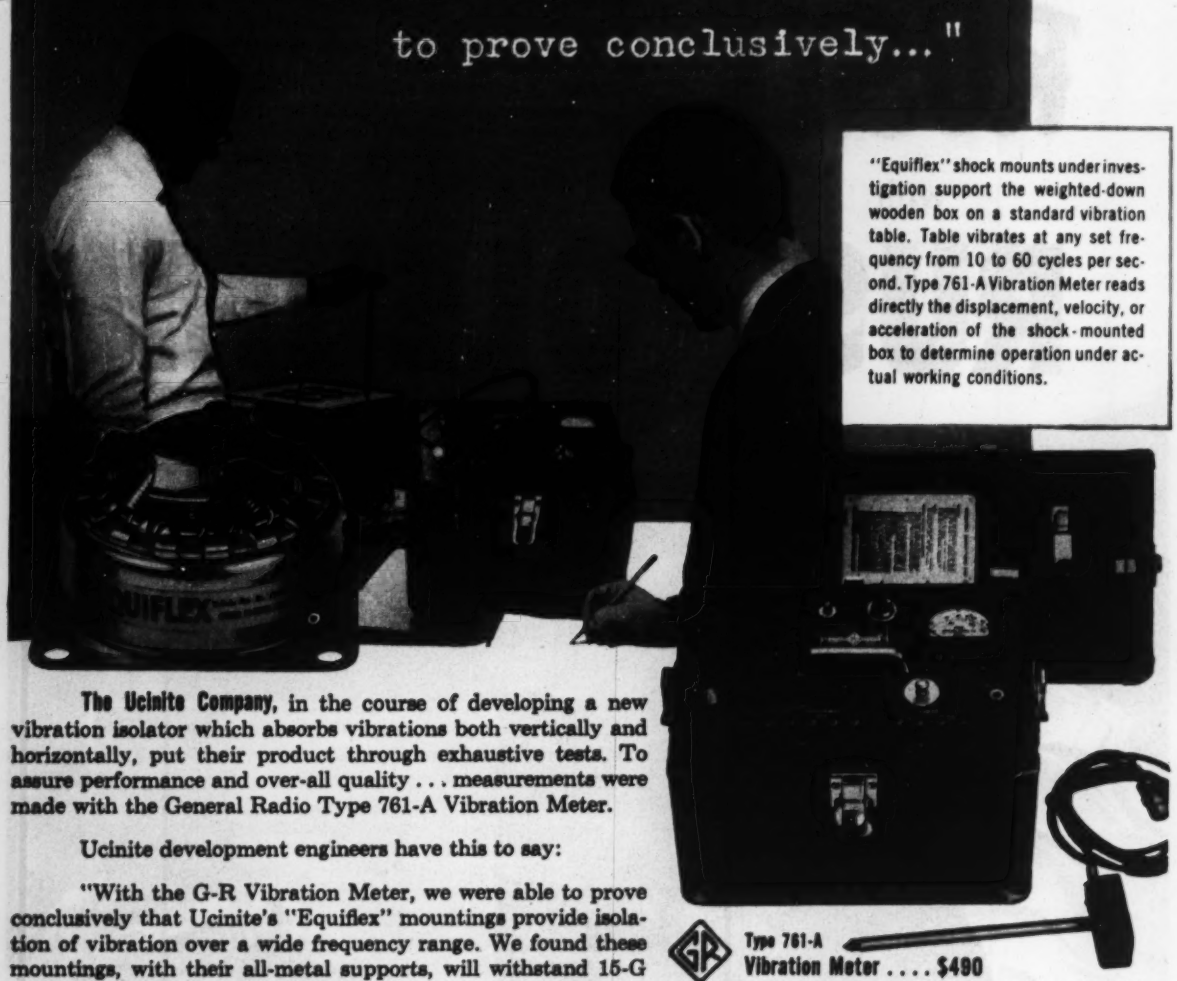
See local classified telephone directory under Rust Preventives or Paints for nearest Rust-Oleum Industrial Distributor.

There is only one Rust-Oleum. It is distinctive as your own fingerprint.

ATTACH TO YOUR BUSINESS LETTERHEAD AND MAIL TO:
Rust-Oleum Corporation, 2963 Oakton St., Evanston, Ill.

- ☐ Please Show Me the Rust-Oleum "Rusted Panel Demonstration."
- ☐ Test Application of Rust-Oleum Over Rusted Metal Surfaces in My Plant.
- ☐ Complete Literature with Color Chart.
- ☐ Nearest Rust-Oleum Industrial Distributor.
- ☐ Nearest Rust-Oleum Dealer.

"with the G-R Vibration Meter
we were able
to prove conclusively..."



"Equiflex" shock mounts under investigation support the weighted-down wooden box on a standard vibration table. Table vibrates at any set frequency from 10 to 60 cycles per second. Type 761-A Vibration Meter reads directly the displacement, velocity, or acceleration of the shock-mounted box to determine operation under actual working conditions.

The Ucinite Company, in the course of developing a new vibration isolator which absorbs vibrations both vertically and horizontally, put their product through exhaustive tests. To assure performance and over-all quality . . . measurements were made with the General Radio Type 761-A Vibration Meter.

Ucinite development engineers have this to say:

"With the G-R Vibration Meter, we were able to prove conclusively that Ucinite's "Equiflex" mountings provide isolation of vibration over a wide frequency range. We found these mountings, with their all-metal supports, will withstand 15-G shocks without damage and will keep equipment captive up to 30 G's.

Where a large number of accurate vibration measurements must be made with a maximum degree of convenience, a precision instrument designed particularly for vibration measurements is definitely needed. The Vibration Meter filled our needs well. Because it measures directly the r-m-s displacement, velocity and acceleration, we were able to quickly and accurately ascertain the vibration efficiency of the "Equiflex" mountings during all stages of design."

Type 761-A
Vibration Meter $490

measures displacement, velocity, and acceleration of mechanical vibrations in machines, parts, and structures.

RANGE

Displacement—16 micro-inches to 30 inches, rms
Velocity—160 micro-inches per second to 300 inches per second, rms
Acceleration—0.16 inch per second per second to 3900 inches per second per second, rms

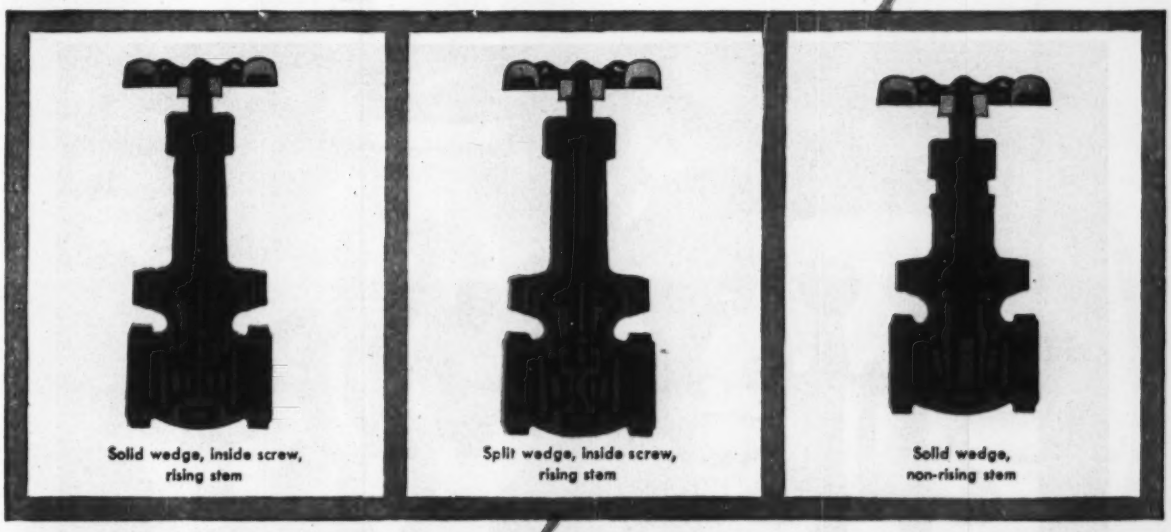
Write for the G-R SOUND AND VIBRATION BULLETIN which describes our complete line of sound and vibration meters and analyzing equipment.

Since 1915 — **Manufacturers of Electronic Apparatus for Science and Industry**

GENERAL RADIO Company
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

Admittance Meters ☆ Amplifiers ☆ Coaxial Elements ☆ Distortion Meters ☆ Frequency Measuring Apparatus ☆ Frequency Standards ☆ Impedance Bridges ☆ Light Meters Megohmmeters ☆ Modulation Meters ☆ Polariscopes Precision Capacitors ☆ Oscillators ☆ U-H-F Measuring Equipment ☆ Parts & Accessories ☆ Signal Generators Wave Analyzers ☆ Variacs ☆ TV & Broadcast Monitors Pulse Generators ☆ R-L-C Decades ☆ R-L-C Standards ☆ Unit Instruments ☆ Sound & Vibration Meters ☆ Stroboscopes ☆ Null Detectors ☆ Motor Controls ☆ Wave Filters ☆ V-T Voltmeters

Oh, I see



Solid wedge, inside screw, rising stem

Split wedge, inside screw, rising stem

Solid wedge, non-rising stem

. . . we've added 125 and 150 lb. bronze gate valves to our union bonnet line

Success of our 200 lb. line of union bonnet bronze gate valves necessitates expansion of the line to include 125 lb. and 150 lb. classes. Sizes range from ¼ to 2 inches.

NOTE THESE ENGINEERING FEATURES:

This line has a flat seat on the bonnet which mates against the body, providing adequate bearing area for sealing.

Tight bonnet joint, but easy access to interior for inspection and service.

Full ports permit unobstructed flow.

Back-seating arrangement permits repacking while under pressure.

Split wedge has ball in socket contact . . . permits wedge to adjust itself to seat.

Slip-on type "T" head stem-to-wedge connection.

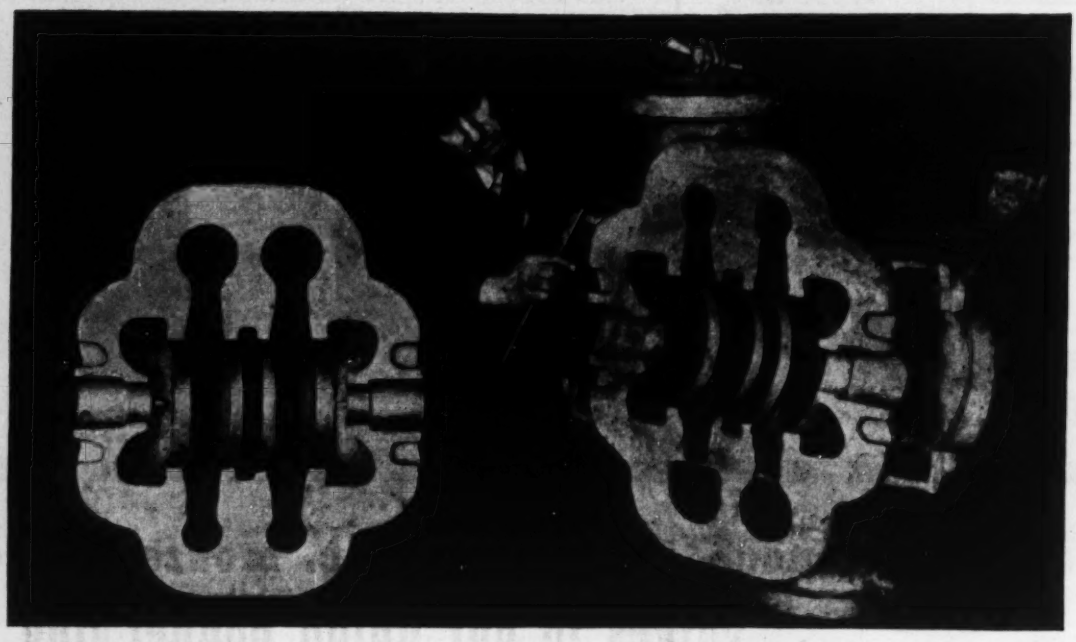
Lug-type hexes make valves compact and provide a better wrench-gripping surface.

To learn more about this expanding line of valves, write for our *Union Bonnet Bronze Gate Valve Catalog Folder.*

WORKING PRESSURES
125 lb. W. S. P. 400° F.
150 lb. W. S. P. 400° F.

THE OHIO INJECTOR COMPANY • WADSWORTH, OHIO

VALVES | **FORGED & CAST STEEL, LUBRICATED PLUG, BRONZE & IRON**



There's NO problem in Stainless Castings that we can't answer for you—

Write for your copy: "ALLEGHENY METAL CASTINGS"

32 pages of valuable and complete data on stainless castings: analyses, properties, technical data on handling and heat treatment, typical applications, how to order, etc.

ADDRESS DEPT. ME-54

Odd shapes or intricate sections are certainly no problem—look at some of our Allegheny Metal casting products illustrated above. We could show you hundreds more. And size is no consideration, either—we're equipped to handle any stainless castings—from a few ounces to thousands of pounds.

The really important point for you to consider is not the matter of shape or size, but of *experience.* The AL Buffalo Foundry is a group of specialists in high-alloy steel castings *exclusively* . . . pioneers in both the static and vertical-centrifugal methods of casting stainless steels.

For your assurance, there's a long record of years of successfully answering difficult service conditions with sound, clean-grained Allegheny Metal castings—free from defects, easy to machine and dependable in supply. ● Let us quote on *your* stainless casting requirements. *Allegheny Ludlum Steel Corporation, Henry W. Oliver Building, Pittsburgh 22, Pennsylvania.*

You can make it **BETTER** with

Allegheny Metal

AL® TIME-TESTED STAINLESS STEEL

WAD 8008 Warehouse stocks carried by all Ryerson Steel plants

SANBORN 150 SERIES
OSCILLOGRAPHIC RECORDERS

The BASIC four-channel assembly includes: Cabinet, Recorder, and, for each channel, a BUILT-IN unit (A), which comprises a Driver Amplifier with frame, and a Power Supply with control panel.

(A)

(B)

You have a CHOICE of readily interchangeable, plug-in Preamplifiers (B) for EACH channel, as described below.

A NEW design concept that brings even greater versatility to industrial OSCILLOGRAPHIC RECORDING

The new Sanborn 150 Series offers greater operating efficiency and convenience, and encompasses a *variety of uses* which include the accurate recording of almost every phenomenon whose frequency spectrum lies in the range from 0 to 100 cycles per second.

A *wide selection* of plug-in preamplifiers, or "front end" units, such as (B) above, are completely interchangeable in any or all channels of the 150 Series amplifier section, where they simply plug in to the driver amplifier and power supply, (A) above, which are already in place.

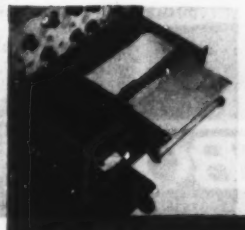
Available plug-in Preamplifiers include: AC-DC, CARRIER, SERVO-MONITOR, DC COUPLING, LOG-AUDIO, and LOW LEVEL. Blank plug-in assemblies are also available for users to make input circuits for special measurement problems.

And, there are the popular Sanborn advantages: a high torque movement (200,000 dyne cms per cm deflection), direct *inkless* recording in *true rectangular coordinates*, and provision for code and time markings.

A new catalog on Sanborn Oscillographic Recording Systems and their components will be sent gladly on request.

OTHER SANBORN IMPROVEMENTS

- Extended frequency response.
- Improved regulated power supply.
- Individual stylus temperature control for EACH channel.
- Improved, single control, paper speed selector. Nine speeds — 0.25 to 100 mm/sec.
- Recorder slides out, if desired, for better view of recorded events, or for notations on record (illustrated at right).
- Improved control of input signals by use of 1, 2, 5 ratios on attenuator.



SANBORN COMPANY
INDUSTRIAL DIVISION

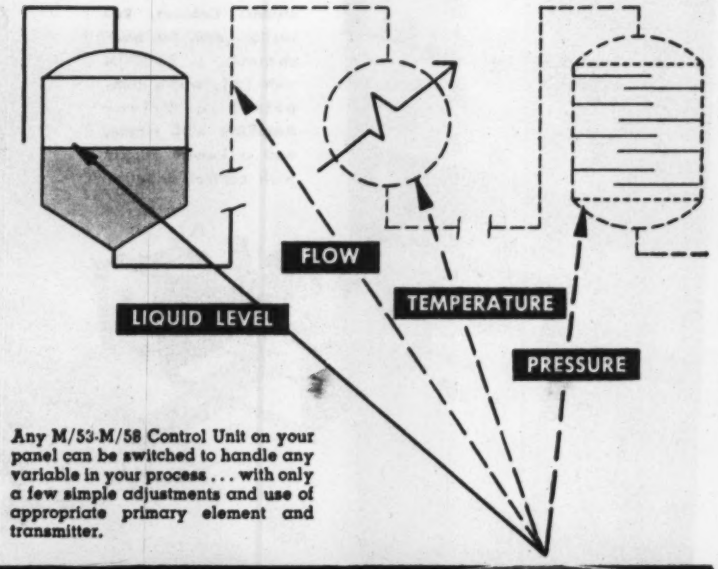
195 MASSACHUSETTS AVENUE
CAMBRIDGE 39, MASS.

No obsolescence for this controller when process requirements change!

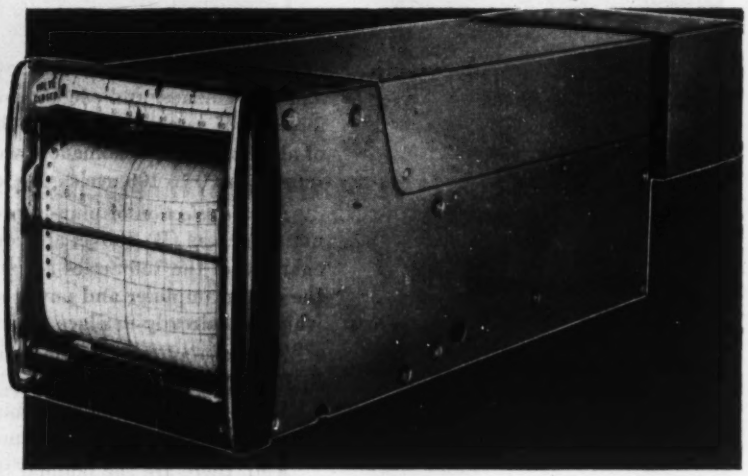
That's right! The Foxboro M/53-M/58 Recorder-Controller is a "universal" instrument, equally adaptable to any process measurement — whether flow, temperature, pressure, liquid level, or other.

All it takes is connection to the proper measurement transmitter having a 3-15 psi pneumatic signal . . . and making the appropriate controller settings. Changes such as adding derivative to reset or proportional control can be made *on the job* without special tools or realignments. You save needless duplication in capital investment . . . save time and trouble in making process revamps . . . and get the unsurpassed performance of M/58 control on every application!

Whether you favor graphic, console, or conventional mounting, you can cut instrument overhead at every stage, step-up efficiency in every operation, with the Foxboro M/53-M/58 Recorder-Controller. Write for complete information. **The Foxboro Company, 966 Neponset Ave., Foxboro, Mass., U.S.A.**



Any M/53-M/58 Control Unit on your panel can be switched to handle any variable in your process . . . with only a few simple adjustments and use of appropriate primary element and transmitter.



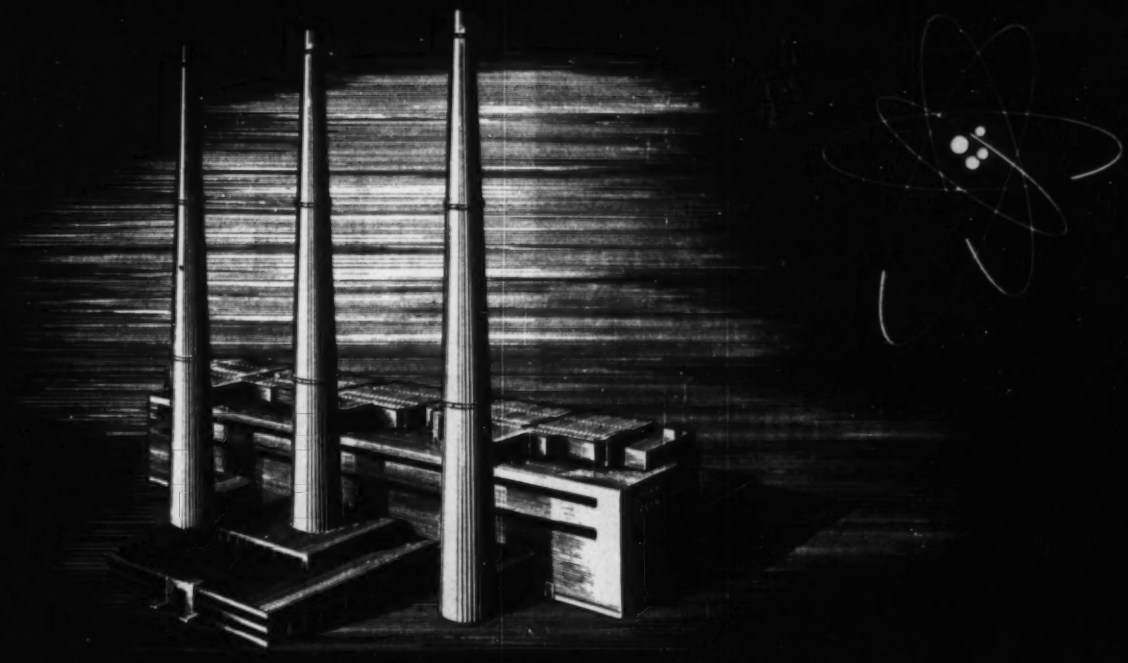
OTHER BASIC ECONOMIES

- **Simplified Ordering**
  —complex specification sheets are eliminated.
- **Reduced Stock Inventory**
  —only one type recorder-controller for all control jobs.
- **Reduced Maintenance**
  —fewest parts, rugged design, no diaphragms, highest quality throughout.

FOXBORO
REG. U.S. PAT. OFF.

Consotrol Process Control

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND



The 1,000,000 KW KYGER CREEK STATION of the Ohio Valley Electric Corporation

Will Have MIDWEST PIPING Throughout

One-million-kilowatt Kyger Creek is the largest privately owned steam generating station for which one company has ever been designated to do both the fabricating and erecting of all piping. Operating conditions will be 2000 psi and 1050°F. Midwest was selected for this outstanding contract because of its long and successful experience in serving the public utilities and its exceptional fabricating and construction facilities.

The Ohio Valley Electric Corporation was formed by a group of 15 neighboring electric light and power companies. Kyger Creek is one of the two steam power plants being built to supply the power needs of the U.S. Atomic Energy Commission's new diffusion plant in Pike County, Ohio.

MIDWEST PIPING COMPANY, INC.

Main Office, 1450 South Second St., St. Louis 4, Mo.

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SALES OFFICES: NEW YORK 7—50 CHURCH ST. • BOSTON 27—426 FIRST ST.
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6739

MIDWEST . . . PIPING FABRICATORS AND CONTRACTORS FOR MORE THAN 50 YEARS

Why ALDRICH PUMPS Reduce Maintenance Cost

ALDRICH

Write for catalogs, engineering service or a representative's call. We invite your inquiries.

Design simplicity . . . rugged construction

Aldrich Pumps are built to take punishing service year after year. You can find Aldrich Pumps, today, in good running order after 30, 40 and even 50 years of service. Durability such as this is the result of Aldrich's design simplicity and rugged construction.

Accessibility . . . sectionalization

When wearing parts are due for replacement, in Aldrich Pumps they can be replaced easily, quickly and at low cost. For instance, manifolds can be moved out on the holding studs and you can lift out and replace valves as complete units. . . . Stuffing boxes are particularly accessible—making it easy to renew packing. . . . To meet a change in pressure or capacity requirements, plunger sizes can be changed — in most cases merely by using new glands, throat bushings and packing in the same fluid-end. . . . Wearing parts are interchangeable among pumps of the same stroke size. . . . Fluid-ends are sectionalized to make possible low cost parts replacement and can be made of stainless steel, bronze, Monel or other material.

Aldrich Pumps Are Used for Hydraulic Systems Involving Operations Such As:

Forging	Stamping
Extrusion	Die Casting
Molding	Descaling

Roll Balancing

Water as Hydraulic Medium Cuts Fire Risk

With Aldrich Pumps *water*—as well as oil—can be used as hydraulic medium. With water, you can eliminate chances of plant damage or injuries due to oil fire . . . and you can reduce hydraulic fluid costs.

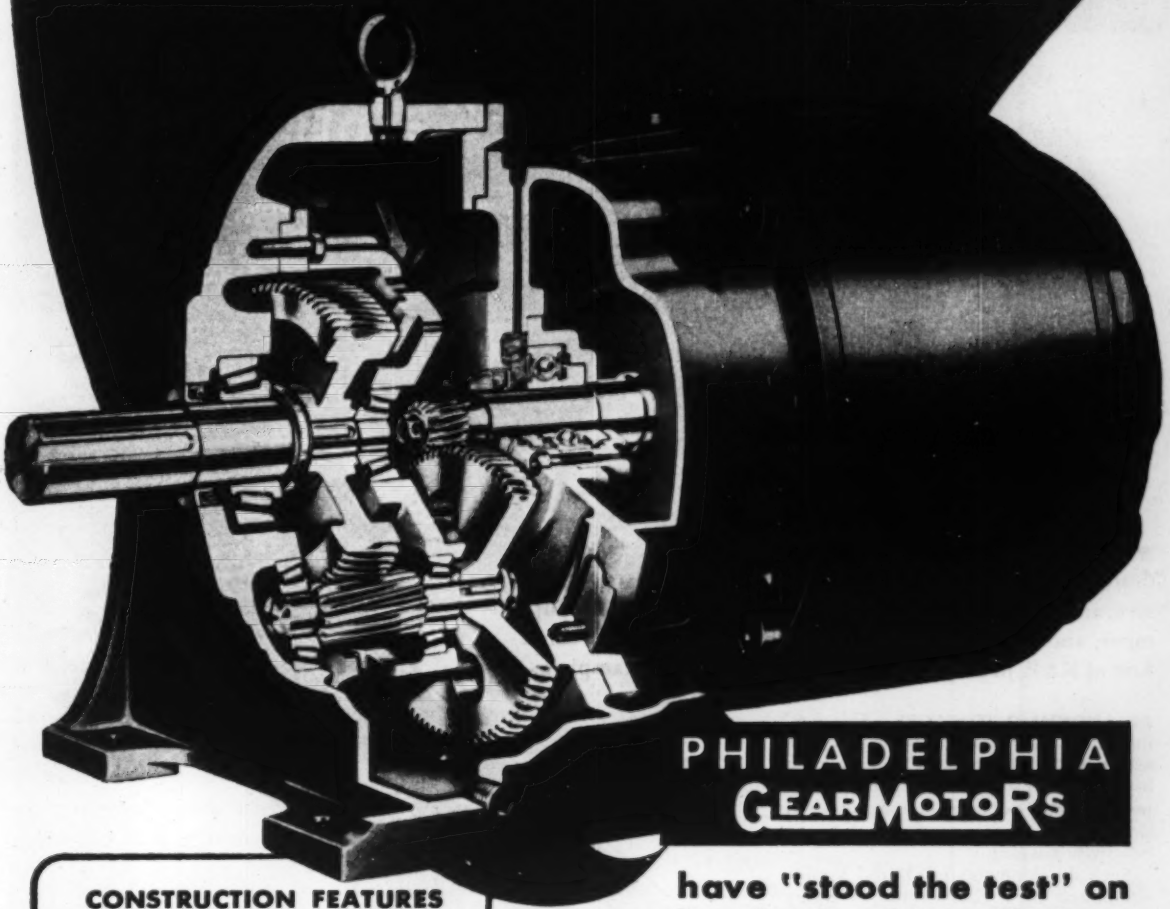
Representatives in Principal Cities

The Aldrich Pump Company

29 Pine Street · Allentown · Pennsylvania

ALDRICH PUMPS RANGE FROM 10 TO 2400 HORSEPOWER

performance leadership



PHILADELPHIA GEARMOTORS

CONSTRUCTION FEATURES

Compact without sacrificing strength or accessibility.

Self-Contained Motor and Gear Unit are combined yet readily separated for inspection . . .

Quiet Simple gear train minimizes number of moving parts and promotes quiet operation.

Standardized Construction Interchangeable parts simplify assembly and maintenance.

Prompt Delivery—Most motors in stock.

have "stood the test" on hundreds of installations

In almost all branches of industry Philadelphia GearMotoRs are giving the trouble-free service that is proof of their excellent design and precision manufacture.

Where the direct application of electric drive to individual machines is desired the Philadelphia GearMotoR will conserve space and simplify the installation as well as offer definite operating advantages.

They are available in single, double and triple reductions with a speed range from 780 through 7.5 R.P.M. Motor ratings run from 1 HP through 75 HP AC or DC.

Our Catalog GM-48 gives full details.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.

NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

7,000

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● **Since 1867 engineers, scientists, designers, surveyors, draftsmen have relied on K&E as the foremost, most progressive, and most complete source of supply for the tools, equipment, and materials they work with. When you buy, think first of K&E, headquarters for 7,000 items. For example . . .**

JIG ALIGNMENT TELESCOPE—This K&E instrument can align a jet plane's wings to within a thousandth of an inch. It establishes optically a line of sight from which measurements can be made and parts positioned with a degree of precision not otherwise possible.

Such developments in Optical Tooling equipment are a combination of eighty-seven years of K&E skill and experience with forward looking research and development in all the fields served by K&E.

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Chicago • St. Louis • Detroit • San Francisco • Los Angeles • Montreal
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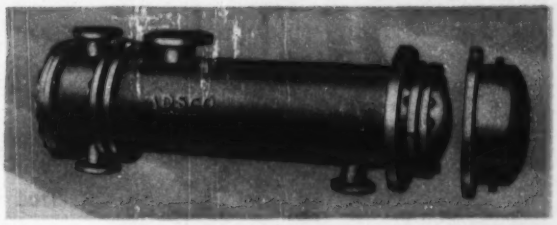
ADSCO ENGINEERED

TO SOLVE ANY HEAT-EXCHANGER PROBLEM

Standard-design or tailor-made, ADSCO heat exchangers are engineered and manufactured to fit the exacting needs of ADSCO's industrial customers. Upon receiving a set of thermal conditions from a customer, ADSCO first applies its many years of experience to the design of the exchanger. And then into the manufacture goes all the know-how which ADSCO has acquired during its 75 years. The result is an exchanger which is not "almost right" but exactly right, a unit of the utmost efficiency... Investigate this specialized ADSCO service. You'll find it is low-cost, yet everywhere carries the ADSCO mark of quality which since 1877 has made ADSCO a leader.



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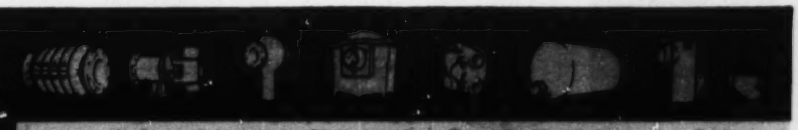

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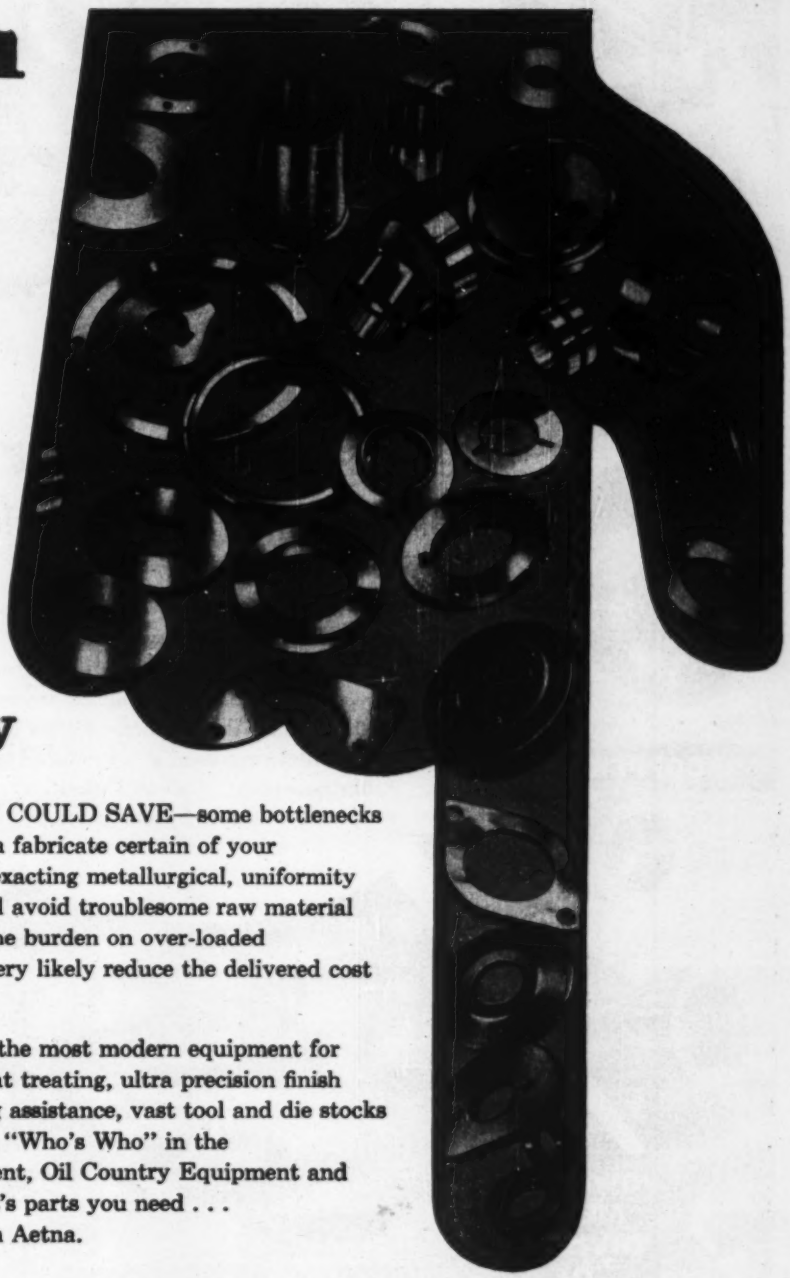

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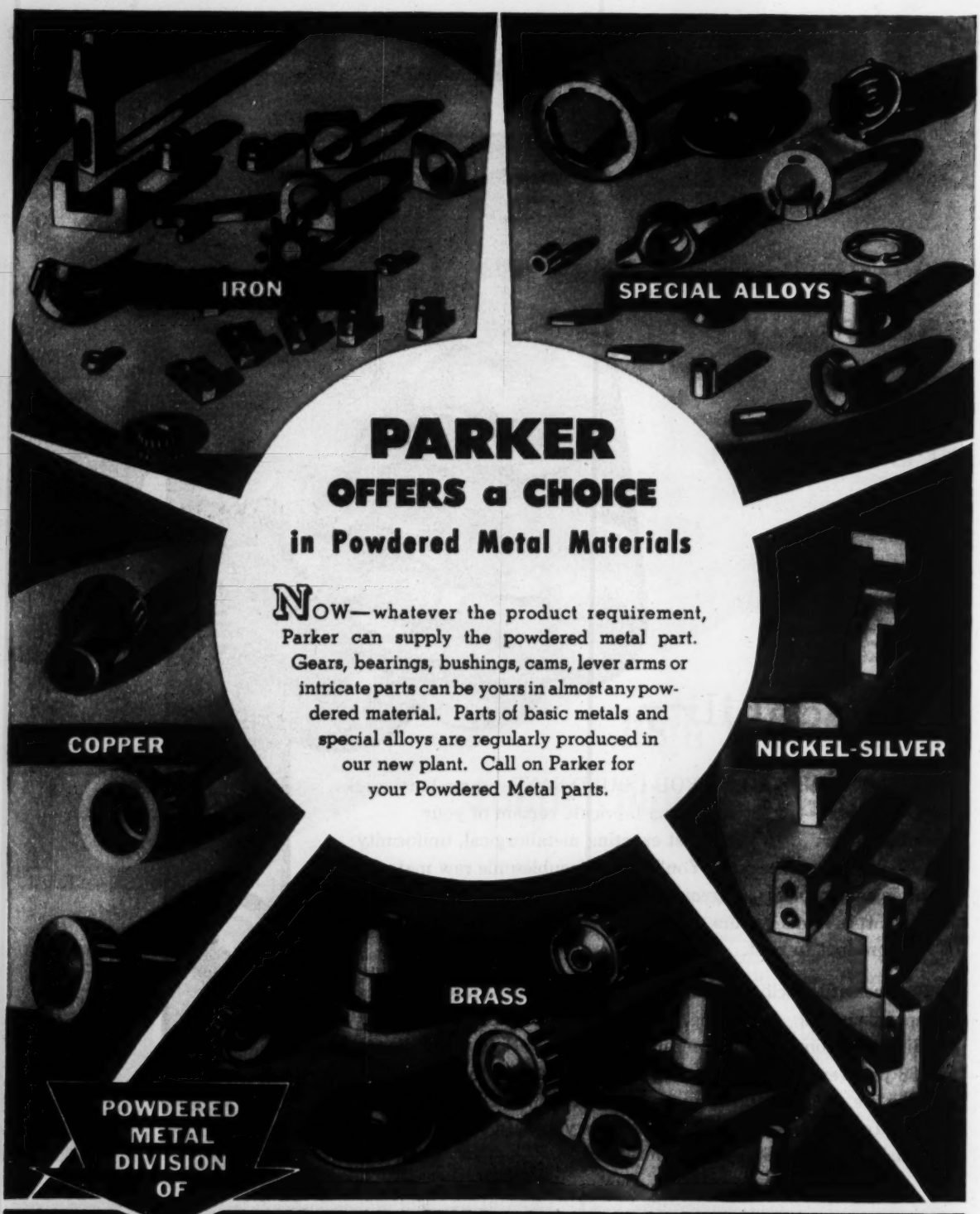
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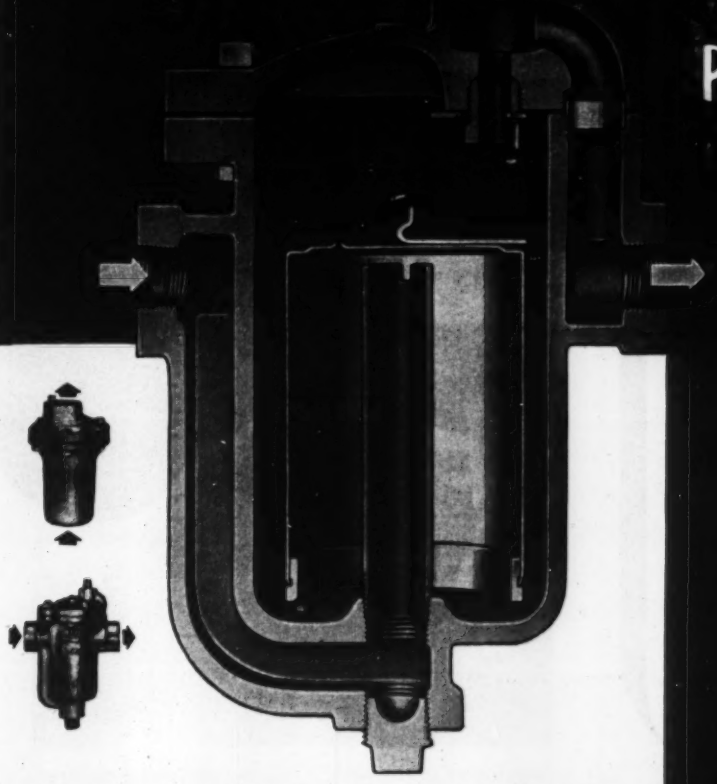

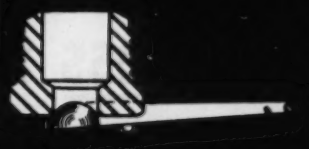

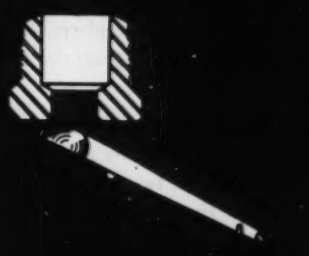

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MECHANICAL ENGINEERING

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Handling "hot" material with "mechanical hands" . . .

. . . such as this one in the "hot cell" of the AEC test facility at the National Reactor Testing Station, Idaho, is necessary because of the danger of radioactivity. The first atomic submarine engine was built at this test station by Westinghouse Electric Corporation.

The Expanding Market for Electric Power

Power production in the United States has grown to 510 billion kwhr. Developments in steam-turbine-generator practice and future possibilities in gas-turbine and nuclear-power plants are noted

By Charles W. E. Clarke[1] and Walter Palmer Gavit[2]

United Engineers & Constructors Inc., Philadelphia, Pa.

GROWTH of the electric-power industry in the early days was slow, but by 1910 there was a total installed capacity of about 4,800,000 kw in the United States, and the annual production approximated 14 billion kwhr. This was about 150 kwhr per capita.

Based on reports to the Federal Power Commission including September, 1953, the total production of electric power for the year by utility and industrial plants was expected to exceed 510 billion kwhr. This is equivalent to an average hourly load throughout the year of more than 58,000,000 kw.

Fig. 1 (annual electric-power production, continental United States) shows the total annual production of electric energy by utility plants—steam, hydro, and internal combustion, from 1920 to date, and that by industrial power plants from 1939 to date, all as reported to the Federal Power Commission. The line labeled, "Total Utility Production," includes privately owned utilities, municipal plants, co-operatives, and Federal power projects. The data for utility plants constitutes substantially 100 per cent coverage. That for industrial plants is based on reports from more than 85 per cent of all plants and is extended by estimate to 100 per cent coverage.

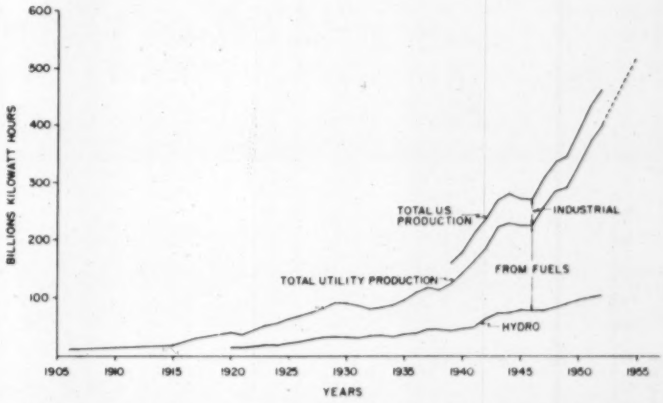

Fig. 1 Annual electric-power production in the continental United States.

Thirty-Year Increase Rate

The average annual rate of increase in utility production over the past 30 years has been about 7.8 per cent, for the past 5 years 9.5, and for the past 10 years, 8.1. Information so far available does not indicate any slowing of the rate of increase; in fact, rather the contrary. However, somewhere in the near or distant future, a point of saturation will be approached and the rate of increase in the use of electricity will tend toward coincidence with the increase in population. There is no evidence today, either statistical or logical, to indicate that time is near.

The increased usage has been general over the entire country, as shown in Fig. 2, which depicts electric-energy production by geographic divisions. The greatest increase over the period shown, 1940–1952, was 4.13 times in the West South Central section and the least 2.09 times in the Middle Atlantic.

Fig. 3 shows total generating capacity installed in nonindustrial power plants from 1906 to 1952. It also shows the total including industrial plants from 1939 to 1952. The nonindustrial or utility power plants plan additional capacity of nearly 11 million kw in 1954, over 10 million in 1955, and about 19 million after 1955. The line in Fig. 3 has been extended to 1955 on this basis, indicating total installed capacity not including industrial plants of about 113 million kw at the 1955 year end.

Fig. 4, plant-capacity loading factors, shows the ratio of national average hourly production to total installed capacity over the past 33 years. The curve indicates a tendency to flatten out and it is probable that this factor will fall a few points by 1955 if the presently planned installations are carried out and production increases at substantially the same rate as has prevailed for the past 10 years.

This plant-capacity load factor is, of course, affected materially by the relation of rate of installed-capacity increase to rate of increase in consumption.

It is reasonable to expect a continuous increase in the efficiency of use of electrical energy as well as the dis-

[1] Vice-President and Consulting Engineer. Fellow ASME.
[2] Consulting Power Engineer. Fellow ASME.

Contributed by the Power Division and presented at the International Meeting, Mexico City, D. F., Mexico, March 10-12, 1954, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

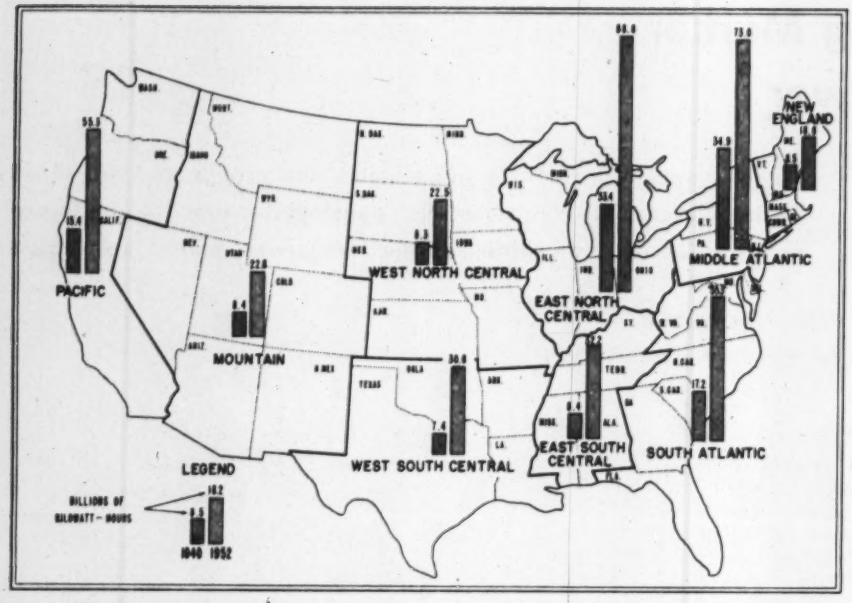

Fig. 2 Electric-energy production by geographic divisions—1952 compared with 1940.

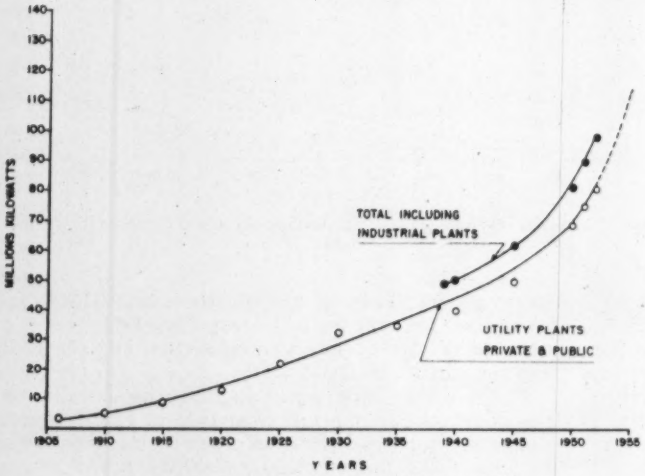

Fig. 3 Installed electric generating capacity.

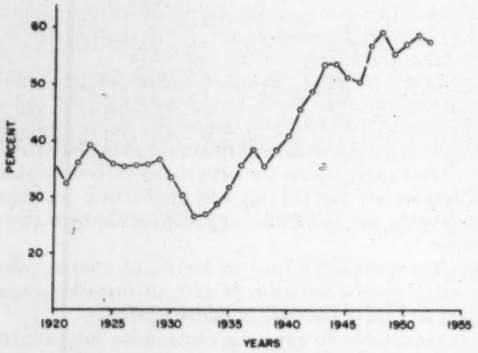

Fig. 4 Plant-capacity loading factors for utility plants.

continuance of some types of uses. Transportation, railways and railroads, for instance, used 5377 million kwhr in 1926 and 5353 million in 1952, a slight decrease over the 26-year period. This undoubtedly is due to the quite general abandonment of electric streetcars.

Annual Sales of Electric Energy

Fig. 5 shows annual sales of electric power for domestic and rural use and for commercial and industrial use, and the percentage of the total represented by domestic and rural uses. This clearly demonstrates the relative importance of commercial uses. Many think of the television and household uses as being of primary importance in the growth of electric-power usage. Domestic consumption has been rising steadily over the past 10 years and is now about 28 per cent of the total. However, during that time and previously, the increased domestic usage has resulted partly from an increase in the proportion of total housing premises that used electricity. As of 1952, over 90 per cent of all households in the country were served so that future increases must soon depend entirely upon the formation of new households and increased use per customer.

Beginning with 1926, Fig. 6 shows the number of residential and rural customers of these classes. There appears to be a very slight tendency to a falling off in the rate of increase. This is to be expected as complete electrification of all households is approached. New households are being formed at a rate of nearly a million a year, whereas customers have been increasing at a rate of almost $1^1/_2$ million annually. The usage in kilowatt-hours per customer, shown in Fig. 7, was 2245 in 1952, and this factor has been increasing at an average rate of about 8.5 per cent per year. The trend indicates a 1955

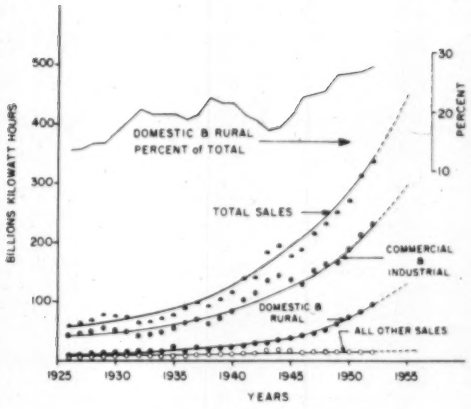

Fig. 5 Annual sales of electrical energy.

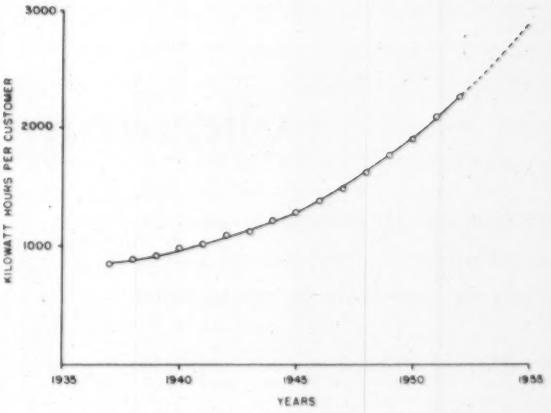

Fig. 7 Kilowatt-hours per customer—residential and rural.

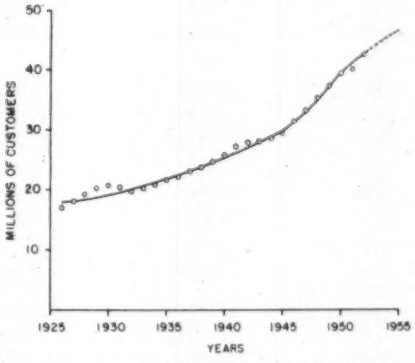

Fig. 6 Number of residential and rural customers.

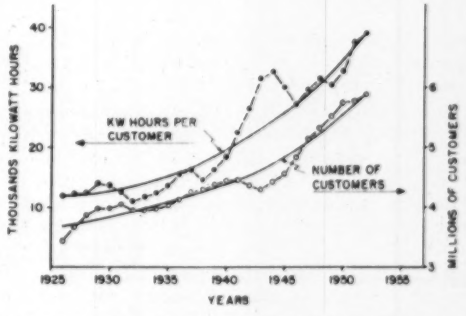

Fig. 8 Commercial and industrial customers.

consumption of about 133,000 million kwhr. This is very close to the extension of the line in Fig. 5.

Fig. 8 shows the same factors for commercial and industrial customers. Both of these curves show a marked effect of changing business conditions. However, it is possible to "fair-in" trend lines, extensions of which indicate a consumption for 1955 of about 300 billion kwhr.

Electric-Power Production Techniques

The growth of the electric-power industry has been accompanied by an almost fantastic development in the technique of its production. Demand for electric energy has been the inspiration for rapid improvement of means for both its production and utilization. Greater availability and lower costs have fostered greater demand. In the early '90's a kilowatt-hour cost the customer upward of 20 cents, and today the national average domestic rate is about 3 cents.

Fig. 9 shows the national average rate per kwhr improvement from 1882 to the present. It should be remembered, too, that the 1890 cent was worth something like three of today's cents. In the '90's a meal could be bought for 20 cents. Today, 3 cents buys a postage stamp.

It probably can be said that the development of electric-power production never could have gone very far except for the invention and development of the steam turbine. Nor would the development of the steam turbine have reached its present status without the demand created by electric-power generation. Top steam pressure which was about 300 psi in 1925 rose steadily to the present 2400 psi, and an installation which will employ a throttle pressure of 4500 psi now is being planned for completion in the next few years.

Use of these higher pressures was made possible only through the development of welding techniques to a point where riveted construction could be eliminated and steam-generator drums be entirely welded. The first welded drums for large land steam generators were made in 1932. Of course in the supercritical pressure ranges no drums will be used which, at least in this respect, simplifies steam-generator construction.

As a result of improved design, increased steam pressures and temperatures, and reheat, the efficiency of power generation was improved vastly. Fig. 10 shows approximate requirement per kilowatt-hour of station output for the country. It also shows the best expected coal rate. It would seem that we were approaching the limit of efficiency for steam cycles. Steam-generator efficiencies are about 90 per cent and turbine internal efficiencies better than 80 per cent.

Steam temperatures were limited in the early days by the materials of construction then available. Intensive research, specifically in development of new alloys and improved manufacturing and treating techniques, have permitted increases in steam temperatures until

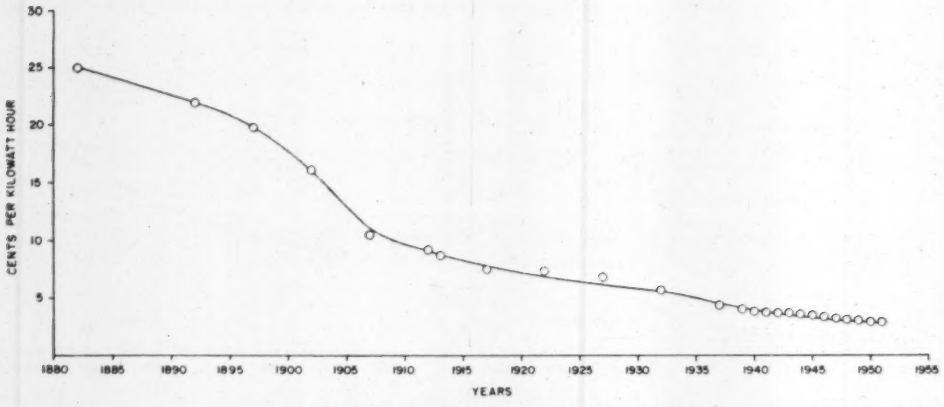

Fig. 9 National average rate per kilowatt-hour.

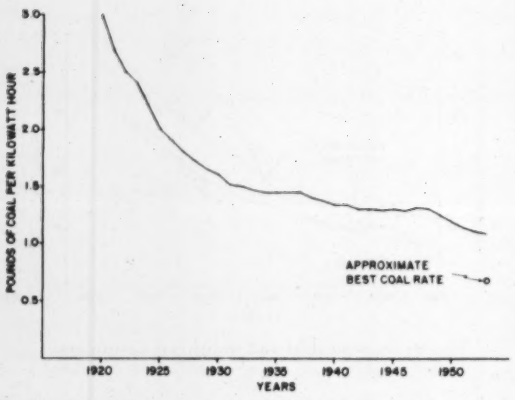

Fig. 10 Approximate average coal consumption per kilowatt-hour.

(Based on coal at 13,000 Btu per lb.)

today 1000 F is common practice, 1050 F becoming more common, and 1150 or 1200 F seems to be "just around the corner."

Higher-Capacity Units

Along with increases in steam pressure and temperature has come a steady increase in capacity of generating units. The largest unit now planned for installation will have a stated maximum capability of 260,000 kw. This unit will operate with throttle pressure of 2000 psi, a total temperature of 1050 F, and reheat to 1000 F. The growth in capacity of units has been possible as the result of a number of developments:

1 Steam at the higher pressures and temperatures has less volume and, owing to the greater heat availability, lesser quantities are required for a given output.

2 Increasing understanding of the mechanical problems involved in high-speed rotative machinery and of the design of turbine blading.

3 Improvements in the design of generators, including closed-circuit cooling and the fairly recent development of hollow conductors through which the cooling medium is circulated, have realized a great reduction in the weight, volume, and length of generators for given output.

The turbogenerator manufacturers state that with presently available materials and knowledge of the art a single-shaft 3600-rpm turbogenerator could be built for a capacity of 300,000 kw.

The highest throttle steam pressure now in use in a commercial steam-electric plant is 2350 psi. This is used at an initial temperature of 1100 F and a reheat temperature of 1050 F. The installation is expected to have a heat rate of 8830 Btu per kwhr of net station output equivalent to about 0.65 lb of average bituminous coal per kwhr.

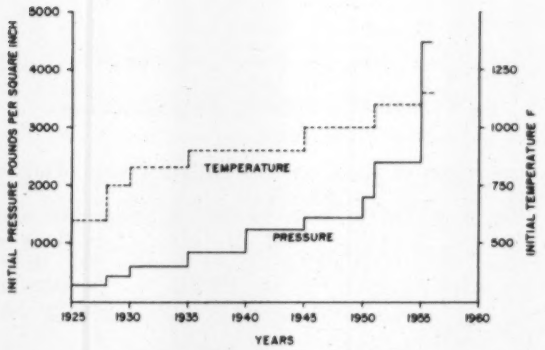

Fig. 11 Advance in steam pressures and temperatures.

As noted in the foregoing, an installation is now in the planning stage that will use a throttle pressure of 4500 psi at a temperature of 1150 F. In this instance the steam will be reheated first at 1150 psi to 1050 F and again at 165 psi to 1000 F. This unit is expected to have a heat rate of 8500 Btu per kwhr of net station output.

Fig. 11 shows the history of the advance in steam pressures and temperatures for 30 years ending in 1955. The fundamental limitation in the efficiency of thermal cycles is temperature. Currently available materials are good for a practical maximum of about 1150 F.

(*Continued on page 508*)

Controlling
Machine Tools Automatically

Automatic controls developed to speed up production range from mechanical to electronic devices

By Frederick W. Cunningham

Arma Corporation, Roosevelt Field, Garden City, N. Y.

Machine tools have been controlled automatically and satisfactorily for a great many years. The automatic screw machine is familar to all engineers. Another type of machine that is widely used is the copying or tracer-controlled machine. This has been developed more recently than the automatic screw machine, and there are many different varieties of these available. On these machines a first piece or template is made by conventional methods, and then a cutting tool is guided automatically so as to duplicate the form in the workpiece. In some cases a master is made of wood and plaster, which can then be cut in metal.

All of these machines have the disadvantage of requiring that a master piece or, in the automatic screw machine, a set of master cams, be made and installed every time the machine is to be changed from one job to another.

When a single piece is required, the simplest way of getting it is probably to hand a rough sketch to a good mechanic and let him make it. If 10,000 or 50,000 pieces are to be made, the machines mentioned are available.

If, however, the number to be made is 6, 10, or 25, there are no good ways of making them. If they are given to a good mechanic, he makes the second piece a little faster than the first, but the third takes just as long as the second, and he easily can spoil the fifth. He has to stop his machine repeatedly to change tools and measure the work. He rarely takes as heavy a cut as the job will stand, as he is afraid of spoiling it, and if he spoils it, he has to start over again.

Tape-Controlled Machines

During the past 150 years or so, these considerations have led to the development of machines that can be controlled by a tape or film. It was about 1804 that J. M. Jacquard invented a loom which was controlled by punched cards linked together in a chain. This control device has been applied to embroidery machines and to lace-making machines. A related system has been used widely for player pianos and organs, and a similar method for the control of typesetting machines.

With a tape system, when new orders come in for spare parts, it is necessary only to take the tape out of the file and put it in the machine, and to put in a piece of stock. In fact the operator does not even need to know what the machine is going to make. He has to know what size stock to put in and where to put it. Frequently, an instrument has a number of similar but slightly different parts, such as shafts of different lengths and diameters, with shoulders at various points. With present manufacturing methods, assembly of the instrument is delayed because one shaft is missing. This is the shaft the assemblyman thinks he needs to put in first. With a tape-controlled machine, it would be easy to produce these shafts in sets.

For exceptionally complicated pieces it is possible to prepare tapes on some of the large modern computing machines. For simple pieces, however, it should be possible to prepare a tape in the user's plant.

If the information can be put on teletype tape, the interesting possibility appears of telegraphing spare parts all over the world.

In the machine-tool field, the problems are somewhat different from those on the earlier devices. Most of these machines employ a hole in the tape for each particular operation or location. On the player piano, the presence of a hole causes a particular note to be struck. On the loom, a hole in a selected location will raise a particular thread.

On a machine tool, it may be desired to locate a point to 0.0001 in. or 0.0002 in. on a machine having a total travel of 50 or 60 in. This is one part in 500,000 or 600,000. Obviously, it is impossible to have a tape 500,000 holes wide, and have each put up a locating pin 0.001 in. from the next one.

Coding Systems

There are several ways to escape the problem. One is to use a coding system of some kind. The simplest system is merely the use of decimal dimensions; that is, if the cutter is to be 19.5732 in. from the zero point, the digits 195732 are punched in the tape. This will require that 60 spaces be available for this co-ordinate. A binary system would permit a reduction to 19 spaces while a combination system using 4 spaces per decade would require 24.

The number of spaces can be reduced greatly if it is not necessary to give a single order that will drive the machine from end to end. If it is possible to put in each

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time an order which does not differ from the preceding one by more than 0.0050 in., it is necessary to put in only the last two digits. If the preceding order had been executed properly, this would be sufficient. The simplest type of control system is one in which successive equal steps are transmitted to the tool. As frequently as the system will allow, a step is either fed in, or it is omitted. Such a system requires a reliable response device.

It also requires a greater length of tape than a control which uses a code to indicate the final co-ordinate of the tool. If the steps are 0.0001 in., and the signals on the tape are $^1/_8$ in. apart, a tape over a mile long would be required to make a single 60-in. cut. At a cutting speed of 1 in. per sec, the speed of the tape would be over a mile a minute. A magnetic tape will permit much closer spacing of orders than $^1/_8$ in., but it is somewhat difficult to make changes on such a tape.

System Flexibility

A matter of great importance to the engineer concerned with automatic control is a knowledge of the degree of flexibility that is desirable to put in a system. It is possible to construct a machine to do almost anything that may be desired under the control of a tape.

Naturally, some things are easier to do than others. If great flexibility is required, additional complexity may result. Cost is the final controlling element. If a machine will not do a job for less money than it can be done some other way, it is not a practical machine-tool control.

The degree of flexibility required depends to some extent on the machine to which the control is to be applied. On a jig-boring machine, the important feature of the control is that it shall locate the workpiece accurately and quickly. A slight lack of uniform velocity of approach is not important nor is control of that velocity over a wide range.

In a lathe, the degree of flexibility required may be important. A simple type of control can be built to do straight turning. To turn accurate tapers may add appreciably to the cost of the control system, while to be able to cut irregular forms may add very considerably. This will be true if the number of orders to be given the machine is to be kept low. If a large number of orders is to be given, as in a step-by-step system, the same control will work on one as on the other, but the labor of preparing the control tape may be increased.

A machine that will do straight turning will do anything if it is done in straight steps of sufficiently small size, but this results in poor speed of operation. It may result in such poor speed that difficulties will be encountered cutting material such as stainless steel, where it is necessary to take a sufficiently heavy cut each time to get below the work-hardened surface from the revolution before. The cost of the control also will be influenced by the number of dimensions. Pieces of course exist in three dimensions but the speed of operation may result essentially in a fourth dimension.

In the case of a round hole, there are four dimensions in a jig-boring machine. There are the X and Y-co-ordinates, the depth of the hole, and the diameter of the hole. Each dimension requires some sort of control system. In cutting a thread there is also the phase relationship of the longitudinal feed to the rotation of the workpiece.

Playback Controls

One type of control which has received much attention in the past is the playback machine. This machine is rather appealing to many people. A machinist operates a machine tool in a normal manner. As he does this, the motions of the machine are recorded in some way on tape or film, magnetic tape or motion-picture film, or anything else. Then when the machine is played back, the motions that the machinist put the machine through are repeated. One of the disadvantages of this is that if the machinist makes unnecessary motions, which he may, those motions are repeated. It is also probably true that a machinist rarely operates a machine tool at maximum possible cutting rates. Especially after the first few operations, he doesn't want to spoil the piece, and he takes extra unnecessary cuts or less speed than the machine is capable of tolerating. In consequence his faults are repeated every time he makes another piece.

Such machines have been described in a number of patents. Some of them are rather old and it is hard to see in reading these patents why these devices have not come into use. They look pretty practical but apparently they have not been used to any extent. It is understood that M. Faure in France is working on a machine on which the record is not made until the operation is complete; that is, a man can take his cut and decide if that was the cut he wanted, and then if it is, he pushes the button and records what he did. If, however, he decides that he should have fed it in a little further because the work comes out a little oversized, he can go back and go through that operation a second time with a suitable correction before it is permanently recorded. That would seem to be advantageous. This is an interesting approach.

Safety Precautions

It is important that the equipment be reliable. Some safety precautions certainly need to be taken. To make the thing completely foolproof is probably impossible. The author's experience with automatic control has been that failures have been mechanical. To be completely, or as nearly, foolproof as possible perhaps would involve a completely double system with two tapes—a transmitting tape which would transmit to the machine tool what it was supposed to do, and a checking tape which would receive information from the machine tool or from the workpiece, perhaps from a diamond that is leaning against the work, or from a point as near as possible to the work. This would transmit from the machine back to the checking tape prepared independently, in which case any discrepancy between the order and the response would result in stopping the machine, or ringing an alarm, or whatever is necessary.

Naturally, the seriousness of a failure will depend on the piece, on the machine tool, on the piece being cut. Anything which may result in damage to the machine tool itself is perhaps very serious. If it damages an ordinary lathe tool, it is not too important. If it damages the workpiece, it may or may not be very important, depending on how valuable the workpiece is. It is important that the machine-tool control be easily serviced. That, naturally, is of less importance as the reliability of the machine goes up. A machine which is likely to break down requires easy servicing; a machine which is unlikely to fail can tolerate some difficulty.

Electronic Equipment Necessary

An important reason that automatic controls were not applied to machine tools many years ago (although patents indicate that people knew pretty much what they wanted to do), was the lack of sufficient experience with servomechanisms, vacuum tubes, and the like. During the past 20 years a great deal of progress has been made in the servomechanism field for military purposes. Vacuum-tube servos and thyratron servos are both reliable. Most failures in these systems have been mechanical. Of course that is true generally. People worry about reliability of vacuum-tube circuits and so on, and yet, loose connections, which are of a purely mechanical nature, are as likely a cause of trouble as anything else. The vacuum tubes themselves do fail, sometimes gradually, sometimes all at once. Of course the all-at-once failure is usually mechanical; grids weren't welded well enough, or filaments broke because of poor welding, or something of that sort. The type of failure resulting from chemical trouble with the cathode, and so on, usually comes up gradually.

Work is being done today with transistors, which it is hoped will be better than tubes. The principal advantage so far is that they don't run as hot as tubes because they have no cathodes to heat. That makes a terrific difference in amplifiers operating at low power levels. Magnetic amplifiers certainly will be used in the future for the somewhat higher power levels, the driving servos. There also are friction drives such as the mechanical-torque amplifiers using metal bands wrapped around drums. For low powers, a straight synchrotransmission has been used. A synchro is very much like a wound-rotor induction motor. If the rotors of two machines are connected together, and the stators connected to a single-phase line, the two machines will rotate together.

The power requirements for machine-tool control may turn out to be surprisingly large. Lathes, for example, may require, under the worst conditions, 3 or 4 per cent of the power required to drive the spindle; that is, a lathe, which is developing 25 hp at the tool may require as much as a horsepower to drive the tool carriage. This takes such servos out of the instrument class, used in computers, and so on, which ordinarily have maximum output of a few watts, and raises them into the power-drive class, perhaps as much power as it takes to drive a 3-in. gun. Of course it is rather unusual for lathes to be delivering as much as 25 hp to a tool, but it is quite possible for a lathe to require over $^1/_2$ hp to drive the carriage.

Computers as Controls

There also has been a great deal of work done for military purposes in various types of computers. These may be of value in the control of machine tools. As yet, they have not been used very widely. For military purposes, computers are used for the purpose of keeping track of the motion of a target, for predicting its position at some time in the future, and for the transformation of co-ordinates from one set of polar co-ordinates to another, as from a set of co-ordinates fixed in space to a set of co-ordinates which roll and pitch with a ship. Most such computers have been analog computers, in which some member rotates through the angle of the ship's roll or pitch, or some function of those angles, and other components then turn to angles proportional to the polar co-ordinates in the other system of co-ordinates, and the like. Computation, of course, could be done by digital methods if the digital computer were sufficiently fast, but as it is necessary to come out finally with a shaft rotation there are, necessarily, analog elements in the digital system.

Tape-Control Machines Constructed

Several tape-control machine tools have been constructed or described within the past few years. One simple system is credited to Dr. Herman Cousins. It makes no attempt to operate the machine tool at its maximum capacity. Its function primarily is to machine parts so intricate as to be extremely difficult to machine by ordinary methods. The equipment uses a tape about $4^1/_2$ in. wide and handles 4 co-ordinates with 16 possible values for each of the co-ordinates. There are 4 tracks in the tape, for each co-ordinate. The combinations of the four of them give 16 possibilities. For every step, 4 holes are punched. They may be in one of two different rows, and there will always be a hole in one row or the other. A small rocker mechanism is brought toward the tape, and rocks one way or the other, depending on which hole is punched. As it moves farther, it encounters a dog which forces the rocker farther in the direction in which it is moving. Then it closes electrical circuits which operate relays to provide any one of 16 different sets of voltages which are fed directly to a synchromotor. This motor simply drives the proper carriage of the machine tool. That means the steps are each $22^1/_2$ deg of synchro rotation, corresponding to a motion of 0.001 in. Synchro motors, when they have such angles as that in them, are capable of delivering considerable torque and power.

If the steps were much smaller it would be necessary to use servomechanisms to aid the synchro in driving the load. There is no provision, at present, for backlash compensation. If the amount of backlash is known, it can be allowed for, or if turning is done from the outside, it is always in the same direction.

If the tool wears, some adjustment must be made. If for some reason the machine fails to respond to one step, the next step will correct it anyway, by moving the synchro 45 deg. For that matter, double or triple steps can be put in if desired, to increase the speed of operation. As long as eight or more are not present at one time, the machine will drive in the right direction. It is probably not advisable to put in more than three, in practice. Considering speeds and accelerations, it might happen that the lags of the system would be such that if two steps of five were put in from a standstill, the resultant rotation would be in the wrong direction.

Numerically Controlled Milling Machine

Another system is considerably more elaborate. That is a numerically controlled milling machine.[1] In this machine, the operation in each co-ordinate is in essentially a straight line although it actually is divided up into little steps each way. However, it is necessary only to put in, in coded form, the length of travel which a cut is to have, and the time which it is to take to complete that cut. The minimum time that can be used is 2 sec.

The machine operates by taking steps at a fixed rate of 512 per sec, and then taking as many of those steps as are

[1] Massachusetts Institute of Technology, Cambridge, Mass.

necessary. If the machine is to travel at full speed, in a second it will take all but one of them. If it is to travel at half that speed, it will take every odd step, or at a quarter of that speed, it will take the second, sixth, tenth, and so on. Intermediate speeds are taken by adding groups of steps. At $^3/_4$ speed, the steps used for half speed are taken with those for $^1/_4$ speed. There is a rather ingenious system for doing this, based on the properties of binary counting systems, and the use of the pulse which does not carry to the next one.

The steps on the M.I.T. milling machine have been 0.0005 in. which gives a maximum cutting speed of 15 ipm. This is a respectable speed, but it is nowhere near the highest useful speed of the milling machine to which it is applied. It is understood that in cutting aluminum it is not unusual to operate these machines at the rapid traverse speed of 120 ipm. On a lathe, it is felt that something around 60 ipm for the longitudinal speed, and perhaps something a little less than that for the cross feed, would be suitable maximum speed rates.

Decade-Voltage-Divider Control

A few years ago, a lathe[2] was built on which the information was fed in, in the form of the co-ordinates of the point at which the tool was to end its motion and the speed with which it was to travel in each direction. Each of these was fed in digitally in the form of a voltage from a decade voltage divider. The voltage divider actually consists of taps on a toroidally wound transformer. It has been found that the voltage from these taps is proportional to the number of turns within a part in 100,000 or better. Even this is not a limitation. By a little manipulation of high and low-speed systems, it is possible to operate to much closer tolerances than this. The velocities when the machine was built were not in as close steps as they could have been.

At the time, it was contemplated that the machine would handle straight turning and rough tapers. Actually, it is possible, with this system, to cut tapers with a tolerance of perhaps a tenth of a degree for whatever length is desired. If it is necessary to have closer tapers than this, they can be cut in steps; that is, a short section can be cut and the machine repositioned. This would leave a visible ring on the work at each such point, but it still would be everywhere within a reasonable tolerance.

As built, this machine was capable of driving the carriage about 60 ipm, at no load. Maximum power was delivered at about half this speed. The accuracy of the machine, or at least its reproducibility, was very good. Successive pieces did not vary more than 0.0002 in. in diam, which is closer than most lathe operators can set the cross slide on a manually operated lathe.

Servo Control for Cutting Noncircular Gears

Another example of an automatically controlled machine tool is a Fellows gear shaper, to which servos have been added for cutting noncircular gears.[3] The principle of operation is that any noncircular gear can be generated by a rolling of the pitch line of a circular gear along the desired pitch line of the noncircular gear. On the gear shaper, the motions available are rotation of the work spindle, rotation of the cutter spindle, and motion of the cutter spindle toward the work spindle. In normal operation of the gear shaper, the two spindles merely are geared together in the proper ratio; the cutter spindle is driven toward the work spindle during a portion of the rotation, while the cutter is fed into the work, and then both proceed to rotate at constant center distance.

In the noncircular case, it is necessary to rotate the work spindle and the cutter spindle at relatively varying rates, and at the same time, to drive the cutter spindle toward or away from the work spindle. The method of doing this is to divide up the required motion of each of these into steps. The steps of work rotation are 2 min of angle, the steps of cutter rotation are equivalent to 0.01 of a tooth, which is 0.15 deg on a 24-tooth cutter, and the steps of motion of the cutter spindle toward the work spindle are 0.00025 in.

The computation is a little involved, but ends up in making steps of any one of the three or any combination of the three motions. The principal features of the system are the use of standard components. There is little special work, as the film is 16-mm film and is run through a home movie projector from which the intermittent motion has been removed. As each spot passes over a phototube, a relay is operated and a stepping switch, which is not used as a switch but is geared to a synchro. The three synchros transmit over to receiving synchros which control servomechanisms on the gear shaper. The operation is not terrificly fast.

Contrast in Control Philosophy

The philosophy of the machine was quite different from the lathe. In the case of the lathe, the object was to make a machine which would be converted quickly from one job to another. It was intended to take only seconds to change a piece of stock and the tape, and only a few minutes to prepare the tape. It was hoped that in making as few as two pieces, this machine would be of value.

In the case of the noncircular gear, the object was to make a machine which would make a piece which was difficult to make by any other known means, and the amount of work required to set up to make this was of secondary importance. Actually, 100 or more hours of calculation and work were required in getting the data on the film. After the first piece is made, if it is found to be not quite right for some reason or other, slight local corrections are made on the film. The error may be due to imperfection in the lead screw, and also to imperfections in the gear shaper, which was not a new machine. However, it is possible to make good gears by this method.

Control Based on Advanced Techniques

The last device to be considered is the only one that has been described so far which uses any of the more advanced techniques of the military computers.

This device[4] operates from punched cards on which successive co-ordinates are punched. These co-ordinates are then reduced to the fourth differences between co-ordinates, which of course, do not have as many figures as the co-ordinates themselves. These differences are fed into a group of roller and disk integrators which integrate the position while the work rotates.

This control has been used for making turbine blades and similar complex forms.

[2] Arma Corporation.

[3] F. W. Cunningham.

[4] Mergler, Marshal, and Young, NACA.

Streamlined drafting results in fewer lines and saves time. The drawings displayed in this class review tell the same story but draftsmen are being encouraged to use the smaller simpler one. The larger drawing, *rear*, required 57 sq ft of drafting paper. The smaller drawing, *center*, required less than 4 sq ft of paper.

Simplified Drafting

How industry, both large and small, can profit by the application of new simplified drafting practices; the educational and training problems involved and how they can be overcome

By Arthur H. Rau

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In this highly competitive era, the challenge to industry, as a whole, is to increase production, cut costs, and continue to improve the quality of the product manufactured. As a key function of industry, drafting must also meet these requirements. Drafting practices and schedules must keep in step with the latest concepts of good management if drafting is to play its full part in the industrial world. The old concept of drafting, which permitted, even demanded, that professional pride find expression in the beautiful and artistically executed mechanical drawing with its numerous accurately projected views and sections, many of which were unnecessary, is today as outmoded as the horse and buggy.

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The "time element" in industrial drafting, as in all other branches of industry, has compelled the adoption of a new yardstick for the measurement of drafting values. Drafting stripped of its frills, yet surrendering nothing in either clarity of presentation or accuracy of dimensions, is the new standard.

Simplified drafting practices embrace many modern economical drafting practices which have been recognized as a real opportunity to increase over-all productivity by improving effective individual performance. Since it is a big subject, discussion will be limited to a few of the easiest and yet most effective practices which can be applied immediately to reduce the effort and time required to make industrial drawings. These are: Simplification of delineation, elimination of nonessentials, and more extensive use of freehand drawing. There are numerous other, equally important and valuable, improved drafting methods and practices described in the

new Healy-Rau 14-chapter book, "Simplified Drafting Practice," published by John Wiley & Sons, Inc., New York, N. Y.

Simplification and Elimination of Nonessentials

Simplification of delineation and the elimination of nonessentials from drawings and layouts offer the greatest inherent possibilities for streamlining drafting and achieving economy all along the line.

In the most simple terms this means merely leaving off drawings and layouts those things which add nothing to their accuracy, completeness, or clarity. The opportunity to effect savings by eliminating "work that should never have been done" presents a real challenge. Some of these include extra views, unnecessary elaboration, unnecessary lines, repetition, conventional representation instead of symbolism, and the like.

The industrial draftsman is a vitally important link between the engineering and manufacturing sections. The medium which he chooses for transferring information from the engineers and designers to the factory should depend entirely upon which method requires the least amount of work and conveys the information clearly and without question. For instance, if it is possible to convey information by word description alone, then no supporting delineation whatsoever is needed, Fig. 1.

Superfluous Lines

Complex parts obviously can be described more economically and successfully with illustrations than with words. For such parts a drawing is made which serves as a framework to support dimensions and other necessary information. Explanations can, however, complement the illustrations, making the drawing of extra views unnecessary, Fig. 2. In other words, a good draftsman should use no more delineation than is necessary to present his story with clarity and completeness. Some drafting rooms which have been using simplified practices extensively for several years have adopted the slogan,

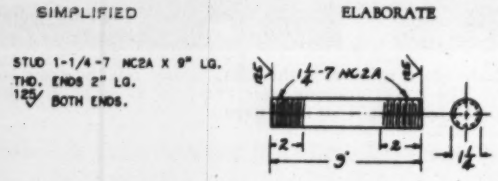

Fig. 1 Use description wherever practical to completely eliminate delineation.

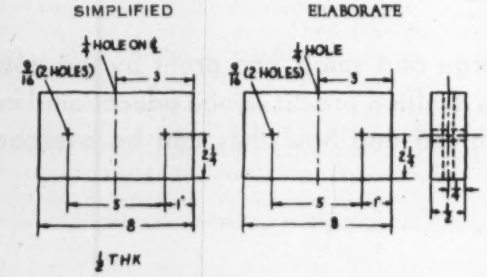

Fig. 2 Use description wherever practical to eliminate projected views.

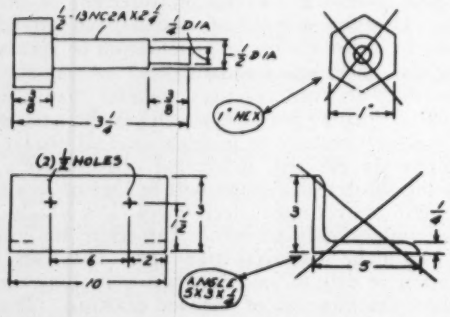

Fig. 3 Eliminate views where the shape can be given by description; for example, Hex, Sq, Dia, on ℄, Thk.

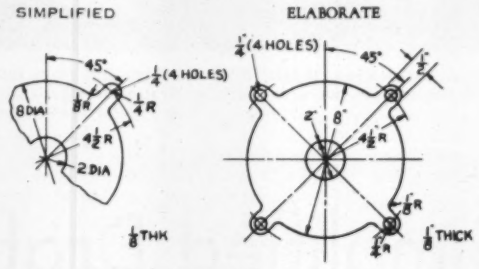

Fig. 4 Show only partial views of symmetrical objects.

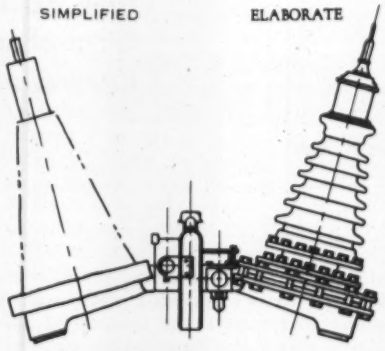

Fig. 5 Avoid the use of elaborate, pictorial, or repetitive detail.

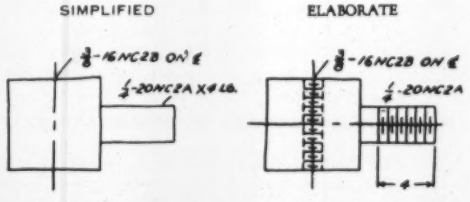

Fig. 6 Where it is necessary to detail threads, do not carry it out completely over full length of a stud, bolt, or tapped hole.

"A superfluous line is a waste of time," a good slogan to remember.

Superfluous lines on a drawing mean not only more time spent in the preparation of the drawing, but, what is far more important, the use of unnecessary delineation or the inclusion of unnecessary information of any kind means a continual waste of time of everyone required to read and interpret the drawing. Fussy detail and too many lines often tend only to confuse the user of the drawing, Figs. 5 to 11.

Practical Applications

Too many hard and fast rules of procedure are not recommended, but the adoption of the concept of simplification should become the dominant thought in drafting presentation. Each draftsman should use good personal judgment in its development and application.

The 27-point illustrations, Figs. 1 to 27, offer some practical suggestions in the application of these principles. They are intentionally elementary and some are not to be considered complete. They have been selected merely to illustrate various points of simplification and establish a basic concept that can be applied to all industrial drafting from the simple detail drawing to the most complicated layout. Although the drawings are of small and simple parts, the same principles apply to larger and more complex drawings, and it is hoped they will stimulate thinking toward this end.

The figures show two sets of illustrations. The "elaborate" delineations are parts of recent working drawings made in various product departments of the author's

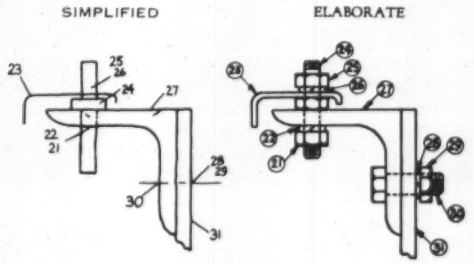

Fig. 7 Omit detail of nuts, boltheads, and other hardware. Show plain outlines where it is necessary to indicate position.

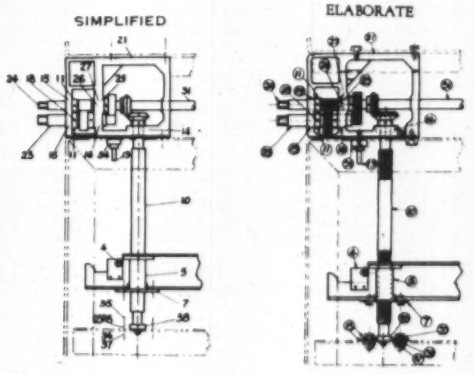

Fig. 8 Omit detail of parts on assembly drawings the function of which is to simply show the part location.

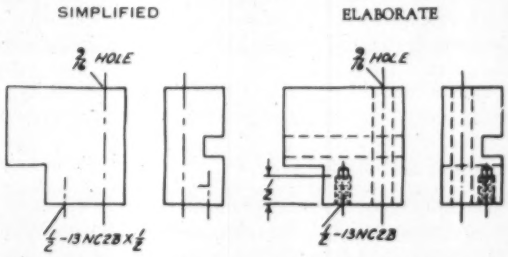

Fig. 9 Avoid the use of unnecessary dotted lines which do not add clarification.

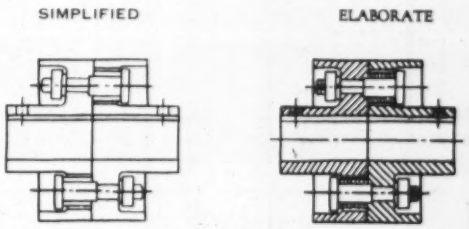

Fig. 10 Cross-sectioning should be employed only when the clarity of the drawing depends upon it. Partial cross-sectioning is recommended.

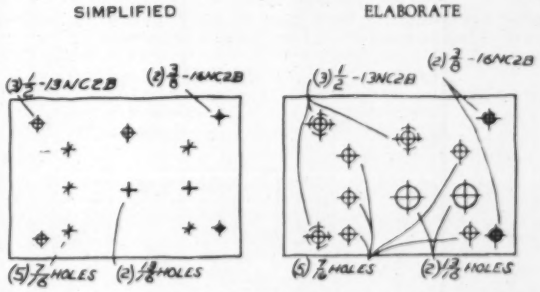

Fig. 11 Use simplified delineation of holes and tapped holes by use of symbols.

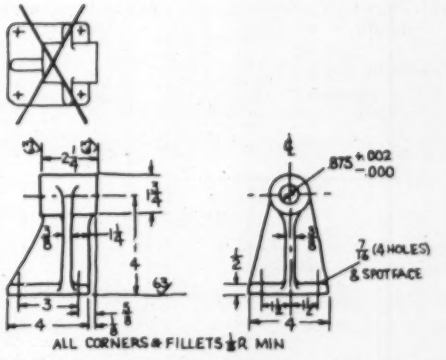

Fig. 12 Views with no dimensional or written instruction thereon can usually be omitted.

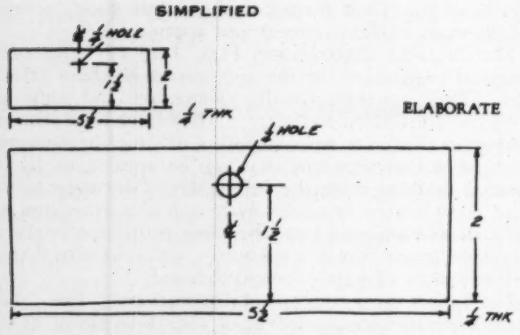

Fig. 13 Within limits, a small drawing is usually made more easily and quickly than a large one.

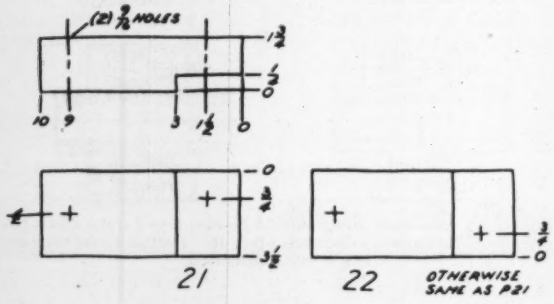

Fig. 14 When two parts are different to a slight degree, complete delineation of both parts is not required. (Inscribed "same as except. . . ," or "otherwise same as . . .").

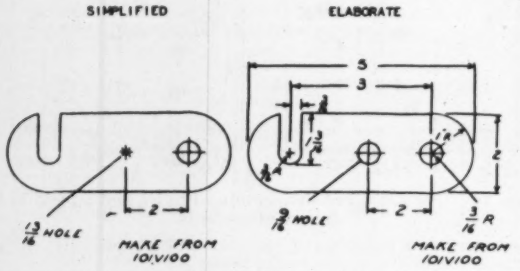

Fig. 15 Drawings made to modify stock or commercial parts should be as plain as possible, avoid detail.

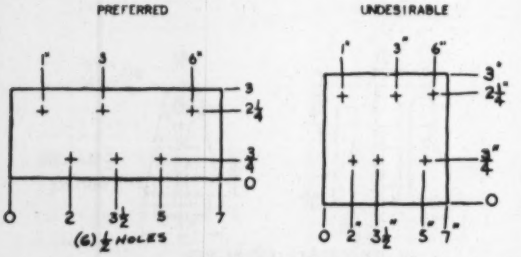

Fig. 16 Draw objects to scale only when absolutely necessary; otherwise, draw objects out of scale but proportionately to the size so as not to confuse the user.

company. The simplified illustrations are these same drawings made over by some of the company's drafting trainees. In making the "simplified" version, the trainees used all the good drafting practices which they had recently learned.

Incidentally, actual timing tests have proved that the simplified drawing can be made in an average of 35 per cent less time. The importance of saving time like this is readily recognized.

Freehand Drawing

Another form of simplification that offers considerable opportunity for further economy in the preparation of industrial drawings is freehand drawing. The challenge to modern drafting is to utilize to the fullest extent the draftsman's ability to contribute ideas for new products or for the improvement of existing products. This calls for reduction of the effort and time required by a draftsman in the physical action of making a drawing, and one of the best ways of accomplishing this objective is through the widest possible use of freehand delineation.

Tests have proved that freehand drawing, when used judiciously, is both practical and economical. With all factors made equal, actual drawing time for the average draftsman is reduced between 20 and 40 per cent.

It is generally conceded, however, that to effect the maximum economy, freehand drawing should be confined to the presentation of detailed parts of simple contour; but even larger and complex drawings lend themselves readily to a combination of freehand and instrument use. On assembly drawings and layouts, for example, small radii, holes, hardware, and the like can be drawn effectively in this manner. It is not necessary or intended that clarity or completeness be sacrificed by this new practice—nor is it an automatic license for careless, sloppy, or indifferent work. Freehand drawing is not synonymous with "sloppy drawing."

To make this practice useful and successful, it is expected that each draftsman will, by using good personal judgment, eliminate as much instrument work as possible and use freehand work on all drawings wherever possible. Many companies now have available standard drawing forms imprinted with nonactinic blue cross-section lines over the entire drawing area. This facilitates freehand drawing, making it quite easy to make a good freehand drawing. The blue grid lines "burn out" when printed and, therefore, do not show on reproductions.

Freehand drawing is only another one of the means for reducing the time and effort required for producing working drawings, but it is an important one. The supervisor's or the draftsman's preferences or previous teachings should have no bearing on the decision as to whether or not freehand drawing will be used. The fact that some draftsmen can and do use this method successfully, thus reducing over-all time and cost, means that the practice could be adopted with profit by all draftsmen.

Education and Training

The introduction of new practices presents a real problem to supervision. The successful use of simplified drafting practices depends to a great extent on the understanding and co-operative effort of the persons actually making the drawings. Supervision may generate ideas,

supervision may plan, but the man at the board, with pencil in hand, is the one who will put the savings into effect. Therefore the job of supervision is to "sell" the value of the new methods to each draftsman and enlist his co-operation to put them into effect. If maximum results are to be realized, the new man must be properly trained and the resistance to change of the "old-timer" must be overcome. This is a real challenge. Drafting supervision must undertake and must successfully complete a project of education and inspiration if the desired results are to be obtained.

In 1952 the author's company organized a formal program and although it is beamed at the man on the board, it is also planned to arouse the interest and enlist the cooperation of manufacturing people and other users of industrial drawings. The specific objective of the program is to develop effective thinking in drafting rooms, and by effective thinking is meant that every draftsman is scrutinizing each drawing, looking at the drafting content objectively for every possible short cut and saving without in any way sacrificing accuracy, clarity, completeness, or neatness.

Instructors have been going from department to department presenting the program to small groups, not exceeding 50 engineering, manufacturing, and production people. Numerous visual aids and other props are used to engage the interest of the audience. Visual cast slides are shown of parts of recent drawings, made by that particular group, selected as examples of the employment of unnecessary detail and extra delineation.

Before reviewing the slides, it is made clear that individual criticism is not a part of the program; therefore all names, locations, and other identifications are deleted from the drawings. References to personalities are intentionally avoided during the discussions.

In this fashion the graphic story of unnecessary delineation and elaboration in industrial drafting is being put squarely before the more than 5400 designers and draftsmen in the company, and the author cannot speak too highly of the enthusiastic support which they, as well as the engineering and manufacturing people, are giving the program to streamline drafting. In almost every instance they were quick to grasp the fairness and reasonableness of the appeal and began to apply some of these simplified drafting practices immediately. Reports of savings in drafting effort and time as well as materials have been numerous and substantial.

Conclusions

The use of any short cut or abbreviated method does not relieve the draftsmen of their obligation to the users of their drawings. A good draftsman's drawings at all times must be clear, legible, and easily understood. It has been found that there is a natural tendency to confuse short cuts with carelessness; therefore, it is emphasized again and again that there must be no compromise with clarity and accuracy.

Another word of warning concerns the program of education in the new concepts. Such a program is not accomplished overnight. It is a continuing one with plenty of "follow-up"—for there is backsliding even in drafting. The extent to which any organization may expect to benefit by the adoption of simplified drafting practices will depend upon the degree of enthusiasm with which the program is tackled and the amount of preliminary work done.

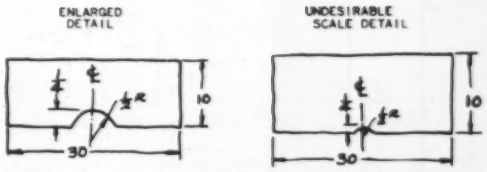

Fig. 17 Enlarge small details on larger parts for clarity when necessary.

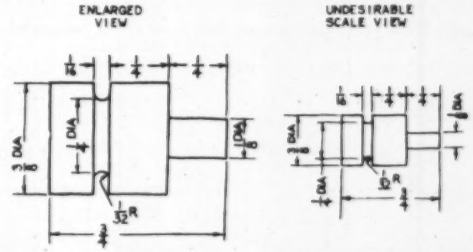

Fig. 18 Draw small parts large enough to avoid crowding so that they may be easily read but not unnecessarily large as to waste space on the drawing.

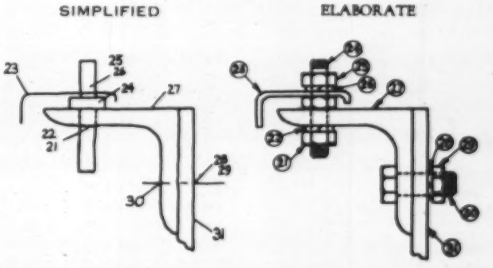

Fig. 19 Omit reference part circles and arrows on leader lines when it will not cause confusion with other data on the drawing.

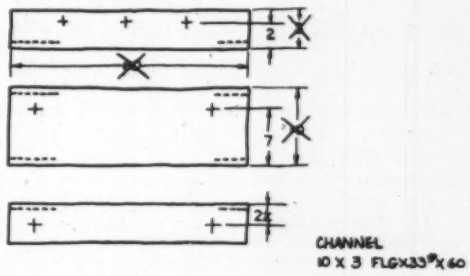

Fig. 20 Do not duplicate dimensions.

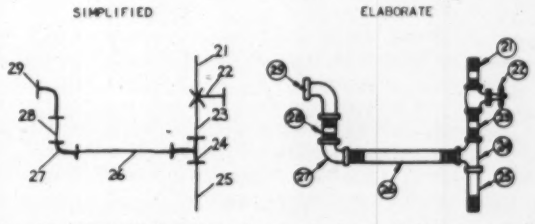

Fig. 21 The delineation of commonly used objects can be simplified greatly by substituting recognized symbols.

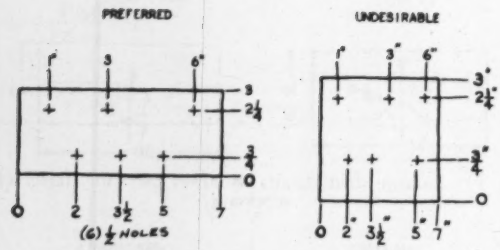

Fig. 22 Omit inch marks when the dimension cannot be confused for a quantity or other data.

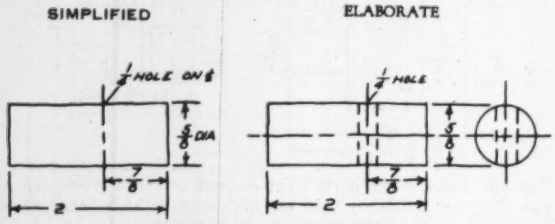

Fig. 24 Omit center lines except when necessary for processing.

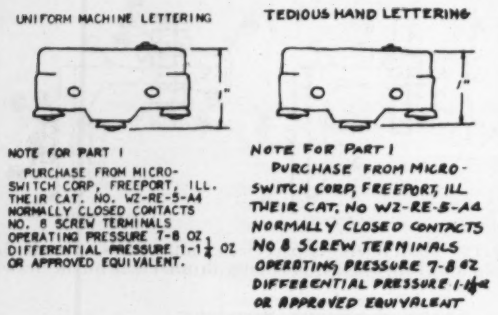
UNIFORM MACHINE LETTERING
TEDIOUS HAND LETTERING
NOTE FOR PART 1
PURCHASE FROM MICRO-SWITCH CORP, FREEPORT, ILL. THEIR CAT. NO. W2-RE-5-A4 NORMALLY CLOSED CONTACTS NO. 8 SCREW TERMINALS OPERATING PRESSURE 7-8 OZ DIFFERENTIAL PRESSURE 1-1 1/4 OZ OR APPROVED EQUIVALENT.
NOTE FOR PART 1
PURCHASE FROM MICRO-SWITCH CORP, FREEPORT, ILL
THEIR CAT. NO W2-RE-5-A4
NORMALLY CLOSED CONTACTS
NO 8 SCREW TERMINALS
OPERATING PRESSURE 7-8 OZ
DIFFERENTIAL PRESSURE 1-1 1/4 OZ
OR APPROVED EQUIVALENT

Fig. 26 Do not use hand lettering wherever typing will save time.

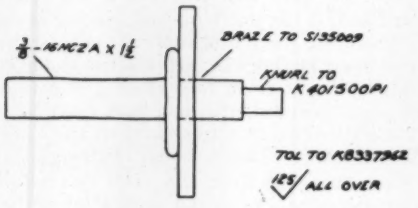

Fig. 23 Eliminate repetitive data by use of general notes.

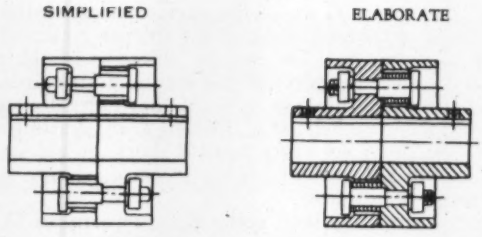

Fig. 25 When delineating, use as much freehand drawing as the work permits in preference to using instruments.

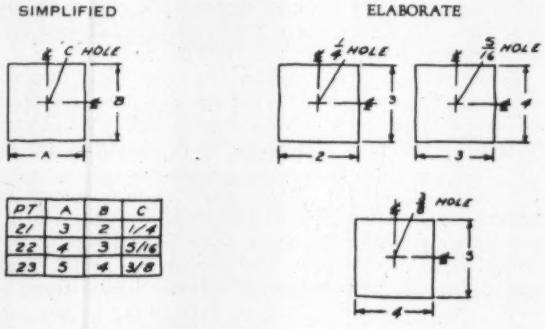

Fig. 27 Use tabulated arrangement instead of unnecessary repetitive views.

In addition, draftsmen must continually keep these facts in mind. The really important part of any draftsman's job is thinking.

The actual picture-making part of the draftsman's job is the least important. They will then quickly realize that drawings are only a means of conveying thoughts to others, and therefore the less time they spend on the actual making of drawings or pictures, the more time they will have available for the real productive effort of *creative thinking*.

Now, as never before, there is a need for increasing personal effectiveness. This need is dictated not only by an acute shortage of trained personnel but also by economic necessity. One of the answers to this need is better over-all efficiency and increased individual output. One means of achieving these objectives is the fuller utilization of the higher abilities of draftsmen. This is a major challenge, and to meet this challenge, ways and means are needed of reducing the time and effort required to make drawings. Simplified drafting practices, if systematically followed, will help to fill this gap. It has been proved that within a three-year period as much as a 35 per cent increase in drafting productivity is possible when all of the known principles of simplified drafting are employed.

Hydraulic Torque-Converter Transmissions for Locomotives

In recent years, hydraulic torque-converter transmissions have been successfully applied to locomotives. Some of their requirements, peculiar to main-line railroad motive power, are explained

By J. S. Newton

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NUMEROUS torque-converter-equipped locomotives are now in service—mostly the smaller industrial type. Several locomotive manufacturers in this country and in Europe offer and produce locomotives having hydraulic transmissions. Those marketed in this country range in capacity from 100 to 300 hp, in weight from 12 to 40 tons, and are of the two or three-axle rigid-wheelbase design. A few of these locomotives have two-speed gearboxes, which permit operation at higher speeds but the usual maximum operating speed is 15 to 18 mph. Several manufacturers in Europe produce and market this same general type of locomotive. In addition, they offer, and the railroads there have in operation, diesel-hydraulic-drive locomotives up to 2000 hp (diesel-engine rating) of the four-axle two-truck type.

Torque-Converter-Drive Specifications

Technically, the following specifications can be written for a torque-converter-drive locomotive for main-line road-freight or road-switcher service in this country. (It should be understood that some of these items may not be applicable to certain locomotives; also, other requirements may exist): (1) The drive should be designed to develop constant horsepower over a minimum speed range of 5 to 1 and 8 to 1 is desired. (2) The efficiencies at all loads and speeds should be equal to those of an electric transmission. (3) The power unit should be mounted in the locomotive underframe—not on the trucks. (4) The design should permit quick and easy removal of individual axles as well as complete trucks. (5) Trucks should be suitable for high-speed service—swing bolster or the equivalent. (6) The locomotive with train must negotiate curves of 21 deg. (7) Multiple operation of units must be possible. (8) Multiple operation with locomotives having electric transmissions is desirable. (9) The drive should permit braking equal to the dynamic brake of the diesel-electric drive where braking power is usually greater than pulling power. (10) Tractive effort must be equal in either direction of motion. (11) The drive must be arranged for zero torque at the wheels when the locomotive is stationary.

Torque-Converter Performance Requirements

In order to establish the performance requirements of a torque-converter transmission, the characteristics of an electric transmission will be examined.

Fig. 1 is a typical full-capacity speed-tractive effort curve for a 1600-hp road-freight or all-service locomotive with an electric transmission. Fig. 2 is a motor current curve corresponding to the tractive effort curve.

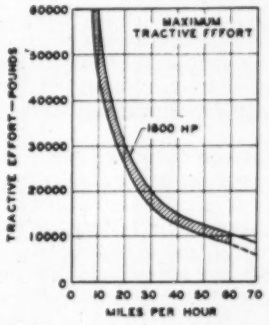

Fig. 1 (*left*) Full-capacity speed-tractive effort curve.

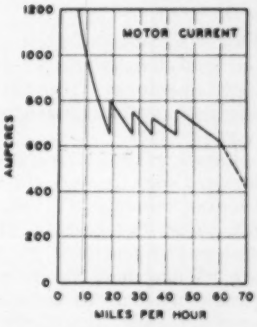

Fig. 2 (*right*) Motor current-tractive effort curve.

With a locomotive weight of 250,000 lb, 20 per cent adhesion is 50,000 lb of tractive effort, and while higher tractive efforts are obtained in service under favorable conditions, the area below 50,000 lb can be considered as the useful area since wheel slippage will occur frequently at higher values. Fig. 2 indicates that there are four abrupt changes in electrical conditions which might be regarded as "gear shifts."

A torque converter consists of a centrifugal pump and a hydraulic turbine in a single casing. If the pump and turbine were separate they would correspond to

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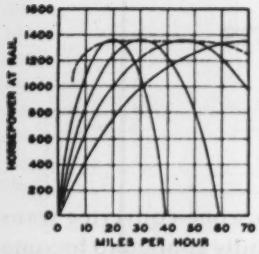


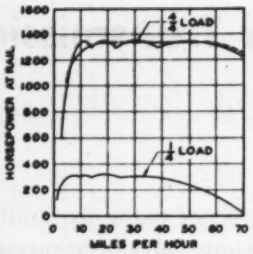
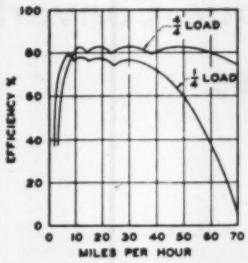
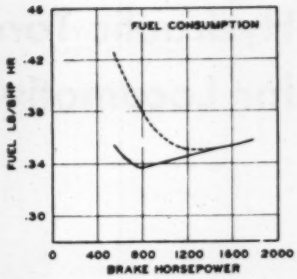


Fig. 3 (*left*) Selection of horsepower-speed relationship by choice of gearing.

Fig. 4 (*right*) Horsepower-speed characteristics of torque converter transmission.





Eig. 5 (*left*) Speed-efficiency relationships for torque converter and drive.

Fig. 6 (*right*) Effect of speed and horsepower of a diesel on specific fuel consumption.

the generator and motor, respectively, of the electrical system. They can be separated, of course, but not without adversely affecting the over-all efficiency and output power. With a constant-speed power unit operating at constant input horsepower, the output horsepower curve and also the efficiency curve take the form of a parabola. By a choice of gearing one of several horsepower-speed relationships may be selected as illustrated in Fig. 3. It will be observed from Fig. 4 that when several gear ratios are used the horsepower-speed characteristic of the torque-converter transmission at maximum output is essentially the same as that of the electric transmission. To obtain reduced output with the torque-converter drive the speed of the power unit is reduced. The peak-efficiency point for any gear ratio moves toward zero mph as the output is reduced. The lower curve of Fig. 4 is for approximately one-quarter load and it will be seen that the peak-power points occur at substantially reduced mph when compared with the corresponding full-load mph peak-efficiency points. This is significant in that to maintain efficiency the partial-load characteristics may require that the transmission have additional "gear ratios" over the minimum that might be considered satisfactory if maximum output only were involved.

Losses in the electric transmission comprise those associated directly with the motors and generators such as friction, windage, I^2R, iron, etc., plus losses in the electric cable, the gearing, the cooling-air system for the motors and generator, the control, and in battery charging. When these losses are tabulated it is found that the peak efficiencies of the electric transmission vary from approximately 70 per cent at one-quarter load to 80 per cent at full load. They occur at approximately 20 per cent of the maximum locomotive speed at one-quarter load and at approximately one third of maximum locomotive speed at full load. At the higher locomotive speeds the efficiencies are slightly lower, due principally to the higher friction, windage, and bearing losses in the motors and gearing. Of course, this effect is greater at the lower outputs than it is at full load. Since light-load operation at the higher speeds is infrequent, it can be concluded that the practical operating efficiency of the complete electric transmission for a 1600-hp locomotive is in the range between 70 and 80 per cent at speeds between 6 and 60 mph, and at loads from one-quarter load to full load. Operation at lower speeds than 6 mph, and at loads below 25 per cent of full load, occurs; however, the fuel thus consumed for a diesel-engine prime mover is a relatively minor percentage of the total fuel used.

Losses in a torque-converter transmission consist of hydraulic losses in the converter, friction plus windage, and lubricating-pump losses for the gearing, friction, and windage losses in the bearings, shafting and couplings, and control power. These losses are not calculable with quite the same degree of certainty as the losses in an electric transmission but it is believed that calculations are sufficiently accurate to permit a fair comparison between the two types of drives. Fig. 5 illustrates the full load and one-quarter load speed-efficiency relationships for a torque-converter transmission and drive. As with the electric transmission, it can be concluded that the practical operating efficiency of the torque-converter drive is in the range between 70 and 80 per cent at speeds between 6 and 60 mph, and at loads between one quarter of full load and full load. Operating efficiencies outside of this area are comparable with those of the electric drive, including the general tendency toward low efficiencies at low loads at the higher speeds.

The effect of engine speed on the specific fuel consumption of diesel engines is important. With the electric transmission the usual diesel-engine idling speed is from one third to one half of full-load speed and the engine speed is increased as the load is applied. In the locomotive manufactured by Baldwin, engine speed at one-quarter load is 65 per cent, at one-half load, 75 per cent, and at three-quarter load, approximately 85 per cent. The specific fuel consumption for the Baldwin 8-cylinder supercharged $12^3/_4 \times 15^1/_2$ 4-cycle diesel engine when operating at constant speed and at variable speed (solid line) is shown in Fig. 6. The specific fuel consumption of this engine at constant speed is substantially greater at the lighter loads as shown by the dotted curve. The speed-load relationship selected for the electric transmission is practically the same as that required by the torque-converter transmission, which means that the diesel-engine specific fuel consumption will be essentially the same for either type of drive.

German Torque-Converter Locomotive

One combination of torque-converter, gearing, and clutches, which has been developed for engines rated up to 1000 bhp and is used in locomotives operating in Europe, is the Mekydro drive manufactured by Maybach of Friedrichshaften, Germany. This consists of step-up gearing between the output shaft of the power unit, a torque-converter incorporating a novel combination hydraulic synchronizing device and clutch, four gear

ratios, selected automatically through a hydraulically actuated control, positive engagement-type over-running clutches, and reverse gearing, all combined into one assembly. It is believed that compound planetary gearing, with friction clutches such as those used in some automotive drives, might be developed to perform the same functions for a 1600-hp locomotive. It could well be that the success of any locomotive gearbox would depend on the proper functioning and service life of the clutches employed to obtain the different gear ratios.

Axle drives of two types are shown in Figs. 7 and 8. Fig. 7 shows a drive developed by the Maybach Company and consists of a large spiral bevel gear mounted on the axle, a mating spiral bevel pinion, other gearing, antifriction bearings, and a housing such that the axle drive plus the wheels and the axle constitute a unit assembly. The axle drive illustrated in Fig. 8 consists of a spur gear mounted on the axle and a mating pinion overhung from the axle-drive bevel-gear unit. In this design there are two assemblies, one consisting of wheels, the axle, the axle gear, and a housing, the same as an axle-hung electric-drive unit, and the other consisting of right-angle bevel gearing, other gearing, antifriction bearings, and a housing.

Multiple-unit operation of two or more torque-converter transmission locomotives can be accomplished in much the same manner as for electric transmission locomotives, but multiple operation of torque-converter transmission locomotives with existing electric transmission locomotives quickly complicates things, principally because there are in existence so many designs. However, it is believed that solutions for multiple-unit operation can be practicable where required.

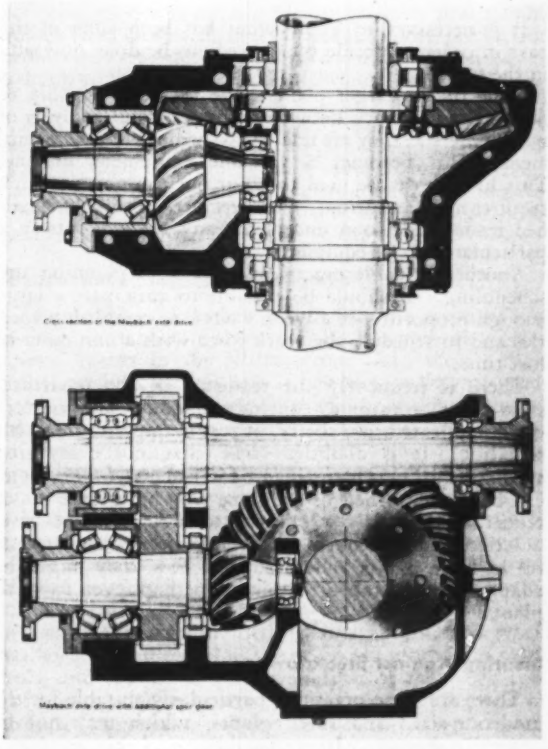


Fig. 7 Axle drive developed by Maybach Company. Top view shows cross section of the axle drive. Bottom view shows axle drive with additional spur gear.

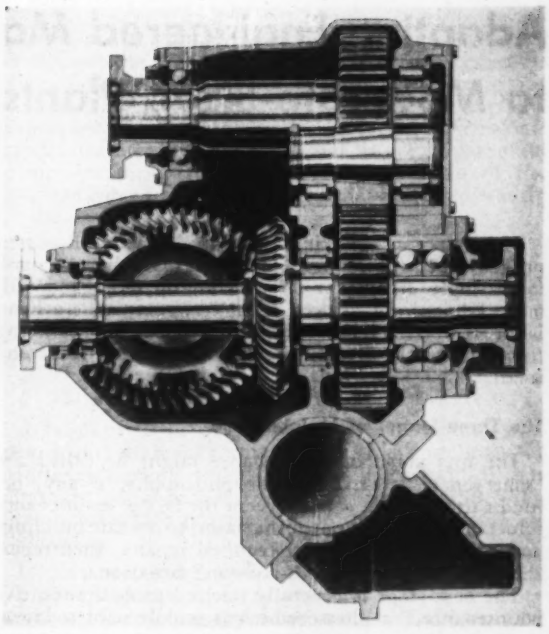


Fig. 8 Axle drive consisting of a spur gear mounted on the axle and a mating pinion overhung from the axle-drive bevel-gear unit.

Braking with essentially the same performance as that of the dynamic brake systems in use on diesel-electric locomotives appears practicable for the diesel-hydraulic locomotive. It does appear, however, that it will require relatively more additional equipment than that used in the dynamic braking system for the electric transmission. Either hydraulic or electric braking may be used with the braking element(s) connected to the output side of the transmission.

Conclusions

It appears that a hydraulic torque-converter transmission can be developed for main-line freight and passenger locomotives for service on U. S. railroads. Its performance both in pulling and in braking will be comparable with that of existing diesel-electric drive locomotives. For equal work the fuel used by a locomotive with this type of transmission will be nearly the same as that of a diesel-electric drive locomotive of the same capacity. Baldwin has an order to design and construct for the Army Transportation Corps a 4-axle road-switching locomotive with a hydraulic torque-converter transmission of the type described. It will be rated 500 hp and will have an axle loading of approximately 30,000 lb. It will not be equipped with power braking. A torque-converter yard-switching locomotive is also being developed by the Electro-Motive Division of General Motors Corporation. After service experience with these locomotives it may be possible to evaluate more accurately the possible advantages and costs of a hydraulic-drive main-line locomotive for service on U. S. railroads.

Adapting Engineered Maintenance to Moderate-Sized Plants

By Charles N. Lanier, Jr.,[1] and James D. Quinn[2]

With increased automation, considerable attention is being directed toward engineered maintenance in the larger industrial plants. Certain of these techniques are adaptable to maintenance activities in plants of moderate size. This paper considers methods for increasing productive capacity through reducing the maintenance work load in plants having maintenance forces of 10 to 50 men.

MAINTENANCE, sometimes described as the ill-gotten progeny of the power age and mechanized labor, becomes increasingly significant as we develop more and still more laborsaving devices in an economy where hand labor is relatively scarce. Maintenance is beginning to command the attention of industrial firms, large and small.

The Three Stages of Maintenance

The first stage of maintenance might be called the "emergency" approach. The philosophy, if any, behind this approach was to accept the fact of maintenance reluctantly and without enthusiasm, to operate buildings and equipment until they required repairs, then repair them. This is the "patch-and-run" situation.

The next stage is generally referred to as "preventive maintenance," a phrase which is widely used today as the hallmark of modern progressive management. Preventive maintenance recognizes that there is a close relationship between usable equipment and output, and that the emergency approach might well find the machine out of service at a critical time. Therefore repairs and overhauls should be anticipated and scheduled. That maintenance, in other words, should be undertaken before the emergency occurs.

It is unlikely that industry will ever be rid entirely of emergency maintenance. Nevertheless, this work can be reduced to a practicable minimum. Preventive maintenance takes the correct approach but requires a bit of refining. The process of reducing emergency maintenance and refining preventive maintenance constitutes the third stage of maintenance development. This might be called "engineered maintenance."

How to "Engineer" Maintenance

The objective of engineered maintenance is that of reducing the maintenance work load to the lowest point consistent with optimum output of the producing facility.

To accomplish this objective, (1) present maintenance activity may have to be expanded or contracted; or (2) work which is presently classed as emergency may need to be put on a preventive basis; or (3) some preventive work may be eliminated and other work expanded; or (4) more or less work may be taken outside. In any case, the "leaky roof, rainy day" approach must be abandoned and management controls be established.

It is necessary to know what has been done in the past in order to decide what needs to be done now and in the future.

Some of the larger plants have found it possible to derive the necessary knowledge by a careful analysis of work orders as they are related to various pieces of equipment. This becomes a valuable equipment history. This history can be used to point out equipment which requires most attention. Furthermore, a properly classified record will soon underscore any weak points in a particular piece of equipment.

Another valuable practice is that of preplanning and scheduling. It should be possible to anticipate a large enough proportion of a week's work to establish priorities and to schedule the work force with a minimum of lost time.

There is frequently the tendency of the moderate-sized-plant operator to conclude that such methods are too complicated, too costly, or just not applicable to his situation. It is doubtless true that not everything accomplished by a maintenance force of 500, for example, can be accomplished in the same way by a force of 30. Nonetheless, it is our purpose to indicate some basic practices and procedures which have been found successful in large plants and to suggest how they might be adapted to moderate-sized plants, perhaps even to small plants.

Insuring Against Breakdowns

There are some practices, particularly suitable for the moderate-sized and small plants, which may not be generally known. It is possible to obtain insurance contracts which will indemnify the insured for losses resulting from equipment breakdown. The insuring

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company, to protect its interests, will provide the necessary maintenance for equipment.

It is possible, also, to obtain excellent assistance from suppliers of equipment and materials. Training programs are made available by producers of such devices as control instruments and servomechanisms. Furthermore, careful investigation of lubricating needs by a supplier of lubricants might well result in reducing the number of oils and greases required, as well as in selecting the correct lubricant for the job it is expected to do.

Another source of help for the smaller maintenance departments may be the production-department mechanical development engineer. He can offer his professional advice from a wealth of knowledge of the production problems. He should be particularly interested in helping to increase production through improved maintenance.

All types of maintenance work offer opportunities to reduce the work load. Work-load reduction is a phase of maintenance operation that is not being given sufficient attention in many plants. The tendency is to accept maintenance as required work and to make it more effective—rather than to consider the basic reason why it was necessary. The smart approach is to adopt the attitude there should be no maintenance and then require justification for all work being done.

Still another source of engineering assistance is available from the technical graduate schools. A competent graduate student could spend a summer doing developmental work in the maintenance program for a moderate-sized plant. The results of his work should be beneficial to all concerned.

Maintenance Practices Investigated

In order to gain further insight into the practices prevailing in moderate-sized plants, the authors visited several plants in the Wilmington, Del., area. These plants perform various operations on a variety of products. They were selected on the basis of the number of employees engaged in maintenance work. As a result of these visits, we concluded that some of the new procedures being introduced into large plants are readily adaptable to the moderate-sized operation.

Many of the larger industrial plants have extremely high maintenance costs. Expenditures in the range of one to ten million dollars a year are not unusual. Figures of this magnitude compel increased interest in maintenance costs. Because of the high maintenance cost in some of the larger industrial plants, considerable work has been done to develop the necessary procedures, controls, and records to permit analysis of the work performed to achieve improved effectiveness. Because of increased automation and the use of continuous processes, the effect of down time for repair or replacement of components has become more significant than formerly.

Many of the moderate and smaller-sized plants do not have a sufficient volume of maintenance work to justify the employment of specialists or staff engineers for the development and installation of an extensive system of procedures, controls, and records that will permit this analysis. However, regardless of the size of the plant, it is necessary to develop a systematic method of conducting the maintenance operation and to accumulate data if the operation is to be improved. Certain of the developments in the larger plants can be adapted readily for the moderate-sized plants.

Basic Requirements

Four of these developments are as follows:

1 The classification of work.
2 The weekly-daily schedule plan.
3 The equipment history for analysis of repairs.
4 The job procedures for improved performance.

A proper type of work order is a basic requirement. Most plants use some form of repair order, job order, or maintenance work order. The kind of form is not important but it should contain at least the following three items which provide the information required for analysis:

1 An adequate description of the work requested.
2 The inclusion in every order for repairs to equipment, an identifying reference to the equipment by name and/or equipment-piece number.
3 A proper classification of the work requested. For this purpose four categories should be considered: (*a*) repairs; (*b*) new work or alterations; (*c*) general maintenance of buildings and services; (*d*) services to operations. Based on the classification, accounting codes or code suffixes can be assigned to segregate costs for different types of work.

Effective Planning

The next consideration is the effective planning of the maintenance work. A system of scheduling work is always desirable but often not considered feasible for small organizations because of the paper work involved. There is a simple method of scheduling that can be considered for maintenance groups large or small.

The schedule sheet can be prepared weekly with a sufficient number of copies to eliminate all daily transcribing of the description of work, codes, estimated hours, and craftsmen's names or numbers, or both. This combined weekly-daily schedule allows sufficient latitude for the foreman to select the men best-suited for the work and available on the particular day when the work should be performed.

Obviously, there are times when it is necessary to perform work which may not be anticipated when the weekly schedule is prepared. This work, usually classified as unscheduled work, can be added to the schedule sheet for the particular day. A weekly review will establish the percentage of scheduled and unscheduled work performed and indicate how effective planning has been.

When work is scheduled on a weekly basis, there is adequate time to plan related shopwork and to make sure of the availability of material, tools, and equipment.

The next step is the development of an equipment-repair history which relates the repair work performed to specific pieces of equipment. Without this, the

over-all maintenance repair cost is known, but there is no way of knowing where the work has been excessive, unnecessarily frequent, or to what extent improvements could be justified. Management should be concerned not only with infrequent high-cost repair items, but also with both minor repairs that occur frequently and with repetitive routine work, such as adjustments and cleaning.

Equipment-History System

Costs of repairs can be compiled through accounting, but for a worth-while analysis of work performed an equipment-history system is a requirement. For the smaller plant a simple form of equipment-history system can be developed. This requires only a different method of filing completed repair orders. Usually the orders are filed numerically or chronologically, and the only change is to file them by equipment-piece numbers.

Of course it is necessary to accumulate data in this file for a period of 3 months to a year or more, depending on the frequency that work is performed, before any analysis is attempted.

Evaluating the History

The equipment-history analysis involves consideration of the total cost of repairs, the frequency of repairs, and particularly, the effect on production as justification for improvements.

A careful evaluation of these factors will give at least partial answers to such questions as the following:

1 Can improved design of components or of the unit be considered and justified?

An important development has been the design of interchangeable and readily replaceable subassemblies for key equipment. This has reduced in-place repair work and the effect on production.

2 Can the use of improved materials of construction be justified in cases where erosion or corrosion is a problem?

When the problem is erosion and design is adequate, hard-surfacing through welding and plating techniques is often considered. Another approach to minimize the effect has been the use of resilient materials, such as rubber, for linings when abrasive materials are being handled. When the problem is corrosion and stresses are low, substitution with plastic materials is being given more attention. Many of the plastics are now being used extensively for chemicals-handling and surface protection.

3 Would improved operating techniques or controls result in less frequent equipment failures?

Investigation of operating procedures or techniques often indicates justification for controlling devices to minimize the effect of corrosive materials being handled, the effect of fumes, or thermal shock. The installation of electrical, pneumatic, or hydraulic controls is often considered.

4 Should preventive-maintenance techniques, such as periodic inspections, adjustments, or replacement of equipment parts be adopted?

The logical approach can be determined only through a comparison of methods and analysis of their cost and effect.

Adoption of the practices suggested by the analysis with consideration for the four points mentioned should assist in reducing repair work to a practicable minimum.

A further reduction in the work load can be achieved by improved job performance of the work that must be accepted. The weekly-daily work schedule will assist the supervisor or foreman to anticipate the job requirements, but there are three questions to be answered:

1 Is the work being performed with a high degree of effectiveness?

2 Are the foreman and craftsman familar with the requirements of the job being performed?

3 How logically is the work planned?

Preplanning the Work

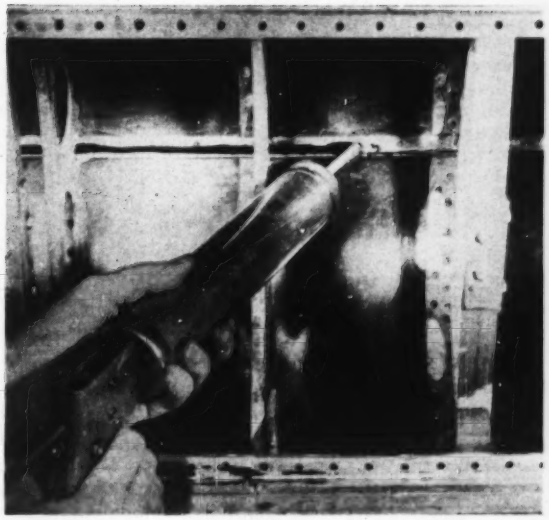
Many of the larger plants have endeavored to answer these questions through preplanning of work and application of craftwork measurement. This required the development of basic time and method and summary time values and training of applicators in the use of them.

As the objective can be to establish a reasonable, though not necessarily an exact time value for maintenance jobs, there is a simpler method that can be considered by the smaller plants. Procedures can be established for minor and major repairs, as well as overhauls, to include a work schedule showing the number and kind of mechanics, the estimated hours, a complete listing as to tools, materials, and equipment, as well as a complete job write-up. Single job plans can be devised for such routine work as lubrication and inspection.

These various procedures are developed in co-operation with the foreman and can be completed as time will permit. They are issued in preliminary form and later rechecked to insure the practicability of the plan. Two important results of this approach are likely to be a significant decrease in the nonproductive time of mechanics, and an increase in equipment operating time.

Engineered maintenance involves a systematic study of maintenance requirements and the adoption of good practices and procedures. It suggests that maintenance be considered with the same care and serious purpose as plant construction, plant operation, and product marketing. It undertakes to lower maintenance costs, but not at the expense of excessive breakdowns and lost production. It recognizes the value of "an ounce of prevention" but insists on knowing how often the preventive operation is necessary. And more than this, it is concerned with over-all reduction in the work load in the long run. It refuses to be fatalistic and to accept present conditions as inevitable.

There are refinements such as backlog controls, control charts, and means of applying other controls to procedures that could be considered for any maintenance operation. However, the major items discussed can be adapted, and should provide a sound basic structure for a maintenance operation in the moderate and smaller-sized plants.



Cold-setting LP-2 adhesive compound seals aircraft wing section.

Polysulphide polymer fluid calking compound seals deck planking.

Mechanical Properties of Polysulphide Polymers

Polymeric products are now being "tailored" to provide new tools and methods throughout industry

By J. S. Jorczak

Thiokol Chemical Corporation, Trenton, N. J.

RETRACING the history of polysulphide polymers, the forerunner was an elastomer with a structure based on ethylene tetrasulphide and identified as Thiokol Type A. It was the first commercial synthetic rubber produced in the United States and developed a limited market despite its high cost when compared with natural rubber and despite a number of serious limitations. It certainly was and still is a difficult elastomer to process. Knowing this, the engineer accepted the problems inherent in the product and applied it to problems which could be answered with no other elastomeric product. To this day this polymer and products made from it are the most oil and solvent-resistant materials in the elastomeric field.

As in the case of nearly every other polymeric product, Thiokol Type A had a humble beginning but it served to open up a new branch of polymer chemistry. A relatively small but capable technical organization was formed to establish and further the exploration of polysulphide-polymer chemistry. Most of the early polymers marketed were variations of and improvements on the initial product, expanding the service-temperature range and improving processibility. A series of modifications led to Thiokol Type FA which today represents the main rubberlike polysulphide product marketed.

In the meantime, other synthetic rubbers, having good resistance to oil and gasoline, were developed. Economics favored these products and only extreme and specialized applications served to maintain a market for polysulphide rubbers. The author's company then turned its research program into a search for other polymeric products to expand its line.

About 1941 a new elastomeric product emerged. It was a highly reactive liquid rubber which could be used as a low to medium-viscosity liquid and made to convert readily to a resilient rubber. Conversion occurs with little shrinkage. Of all the polysulphide polymers developed, the line of liquid polymers has been of greatest value to development engineers. There has been continued and widespread interest in applications other than those normally associated with the rubber industry.

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During the years 1952 and 1953 the Technical Service Laboratory has been exploring the properties of reaction products of epoxide resins and liquid polymers. Contrary to the general trend in use of mixtures where the poorest mechanical property remains dominant, reaction products based on "epoxides" and liquid polymers develop mechanical properties superior to either one of the polymers by itself.

Polysulphide Rubber

The cured products have a number of advantages. The rubber is composed of saturated and normally linear chains resistant to absorption of and breakdown by oxygen and ozone. General resistance to swell in ketones, acetates, gasoline, and aromatic fuel blends is still the best (markedly superior to the best commercial chloroprene and butadiene/acrylonitrile rubber compounds). Disadvantages, and therefore limitations, are poor in resistance to deformation under load especially at elevated temperatures, low tensile strength, and mediocre abrasion resistance when compared with most common synthetic rubbers. The source of structural weakness is still a puzzle to Thiokol chemists and it is hoped that a solution will be found in the future to improve the over-all mechanical properties.

Most of the uses stem from the unusually good aging and solvent-resistant properties. Today's paints and inks use fast-drying solvents, and the demand for paint spray hose and printers' rolls manufactured from polysulphide rubbers has been increasing steadily. One of the chief limitations—deformation under load—is actually a desirable property in the case of permanently flexible sealing putties. Excellent calking compounds have been formulated from Thiokol Type FA rubber. Combined with permanent flexibility, the putties have good bonding to wood, glass, masonry, and metal surfaces. Water vapor or water penetration is extremely low and the products have the good weathering properties normally associated with polysulphide polymers.

Flexible relief maps are made with LP-2 as the base polymer.

Polysulphide Water Dispersions and Liquid Polymers

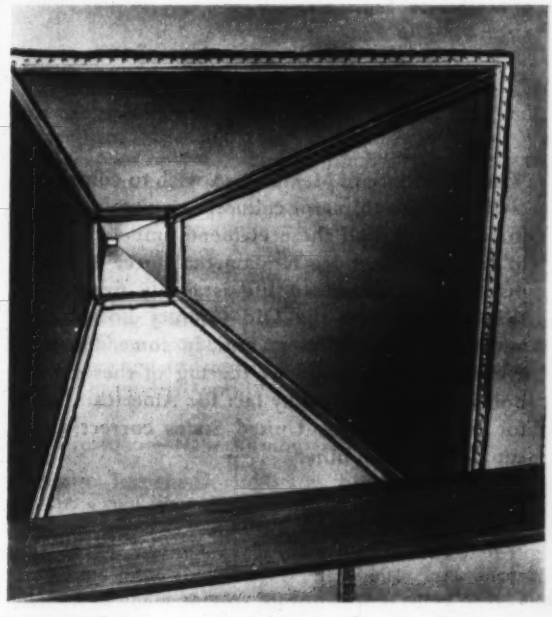
The products are manufactured and sold as suspensions in water. They are called water dispersions rather than latices because the average particle size will vary from 5 to 15 microns whereas the average particle size in a typical latex will fall below 1 micron. The advantages again are good aging and solvent resistance, and also low moisture-vapor transmission. The disadvantages are similar to those stated previously for the rubbers.

There are several small and specialized uses for the water dispersions and one use appears to answer some current problems. The advent of high operational speeds for aircraft has resulted in serious damage to propellers and leading edges on aircraft through rain and sand erosion. Thiokol-modified vinyl coatings have been used successfully to overcome this erosion problem. Two water dispersions have been found effective—Thiokol Type MX and WD-6. In essence, the polysulphide-polymer particles are distributed as fine rubber agglomerates in the vinyl film. The agglomerates are non-extractable and serve as permanent plasticizers or flexibilizers. Several other advantages are gained, i.e., higher solids with fewer coats required for paint application, fewer holidays in the paint film, and extremely low moisture-vapor transmission. Vinyl paints based on "vinyl-Thiokol water-dispersion" systems have found a market in protective paints for corrosion resistance, especially in chemical plants.

Liquid polymers vary in average molecular weight, viscosity, and reactivity. The reactive group

Polysulphide protective resins prevent corrosion in electrical connectors.

is thiol (SH) and it is versatile indeed. Most uses stem from the application of a product in the liquid state with subsequent conversion at ambient temperatures to a rubber. The rubber so formed has excellent aging and solvent-resistant properties and performs well over a temperature range of —70 to 300 F. Limitations as a rubber-like material are found in low tensile strength and moderate abrasion resistance. Also, usually conversion takes



Polysulphide putty seals lenses in directional microwave antennas.

place rapidly by a process of oxidation so the converting agent must be kept separate. Formulations are generally designed as two-package mixes.

Two factors—application as a fluid or paste and the versatile reactivity of the thiol (SH) group—have resulted in a rapid growth of interest by engineers in many industries. Although the early polysulphide rubbers served only a limited number of uses in the rubber industry, their application has been confined to special uses in this industry and market growth has been slow. On the other hand, growth and diversification of the market for liquid polymer has been rapid and but a small percentage of the market has been developed in uses related to the original rubbers. The bulk of the current market for liquid polymers is in adhesives and sealers. Recently the reactivity of these polymers with epoxy resins has opened new fields in adhesives, potting, and coating compounds.

Typical Applications of Polysulphide Polymers

In marine work the polysulphide polymers have found wide use for sealing windows, calking deck seams, and a wide range of applications where watertightness is required. On tankers, suction and discharge hose is subject to great stress in service. Cuts, tears, and snags in the outer covering can be repaired quickly on the spot with a special polysulphide-polymer compound.

For mechanical seals and packing, leather is an established product. For high-pressure service, however, it is found to be too porous and leakage occurs. Impregnation of leather with Thiokol LP-2 or LP-3, followed by conversion of the liquid to a rubbery state within the voids of the leather, results in a new product having the combined properties of leather and rubber, overcoming the difficulty.

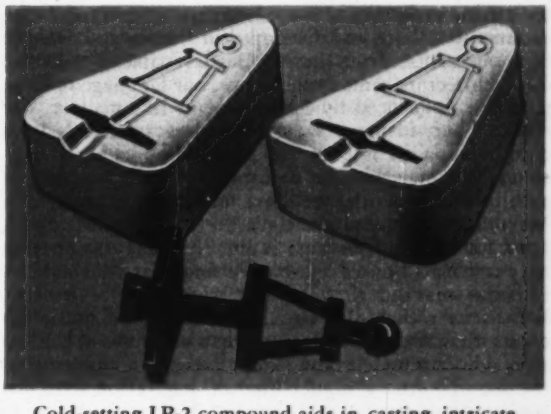
In pottery plants and pattern shops, casting of intricate shapes with undercuts requires an elastomeric compound. Good dimensional stability is the major requirement. A cold-setting LP-2 compound was developed for ease in pouring. By the use of this compound, intricate cavities are filled with a fluid which converts to a flexible rubber that conforms exactly to the shape of the cavity or mold walls.

Another similar application is the making of flexible relief maps for radar-training purposes.

Sensitive electrical compounds must be embedded in a protective resin which now is provided by a ratio of LP-3 to epoxy resin which has the correct mechanical properties to withstand temperature cycling.

In the aircraft industry, a cold-setting LP-2 adhesive compound has been developed to seal between faying surfaces, over rivet heads, and as a filleting compound at the joint areas between sections.

The foregoing uses of polysulphide-polymer compounds are only suggestive of the wide range of applications of such products throughout industry today.



Cold-setting LP-2 compound aids in casting intricate shapes.

Cast plastic venturis made from LP-3 and epoxy resins.

The *Meaning* of Mexico

By Lewis K. Sillcox

President, The American Society of Mechanical Engineers

What is the lure of Mexico? A wish to compare civilizations, a thirst for culture, escapism, a hope for adventure; all these elements impel people to travel but a more fundamental force is also discernible. American life is firmly fixed between two poles—the Old Country homeland and the rugged frontier; and, in some degree, everyone is influenced by the tug of these two poles. This is a healthy fact for American life, for Mexico and the United States correct and supplement each other.

The polite, artistic, mature civilization of Mexico, with all its lessons from the past, and the strenuous self-reliant temper of her neighbor to the north, with all its ambitions for the future, creates divisions of opinion and outlook which are truly challenging. As generations pass, the United States inescapably becomes a more mixed people, the blood of dozens of national groups mingling indistinguishably; and the memory of far-off origins inevitably becomes dim but that of nearby Mexico becomes richer through the convenience of association such as we are at this time privileged to enjoy. But other ties than blood, fortunately, have an increasing strength. Above all else, the real meaning of Mexico resides in the grandeur of her cultural heritage; a heritage we share and against which we measure our own performance. For nearly all the culture of our two countries, including the consummate culture of a free country, was born and developed in Europe and came to both our nations from there. Our law came from Rome, our architecture came from Greece, our language in large part was influenced by Spain, and in like manner, our music. But, in many ways, our Mexican friends have done more with it than we have through their transcendent achievement in painting, sculpture, music, and architecture. While we have produced great talent, Mexico has produced great genius. A trip to Mexico is good for the soul, because it quickly reshapes our tendency toward a limited view. We find that Mexico City is better planned than any American city of its size. We discover that Mexico enjoys more good music per capita than we do. We learn that you have a University, whose grandeur and extent presents a challenge to the world. And a higher kind of inspiration than any we have yet named comes from the constant rediscovery of Mexico. This is the spiritual impulse which is the most important part of the stream of its civilization. Visitors, such as we are, gain a sudden revelation of the spiritual wealth of the past by coming into its midst. We draw in the meaning of Mexico with the air we breathe.

Mexico, Peacetime Friend

Relations between Mexico and the United States have seldom been better than at the present time. The underlying factors which condition the position of the two countries toward each other are fundamentally sound. The general atmosphere of harmony in the diplomatic realm is more than a superficial accord pressed on both in response to troubled world situations. It has solid roots both in peoples and their governments. Mexico has taken giant strides toward solving many of its long-standing domestic difficulties. Real inroads have been made on political, social, and economic problems. Five or ten years ago the popular and technical reports about Mexico were tinged with a pessimism then shared by Mexicans. Most of the gloomy predictions of 1945 or thereabouts have now been reversed because of recent accomplishments. These have created a salutary climate of optimism and high national morale that promises well for the future, even in the face of the barriers which remain. The record of recent years is one of significant achievements.

All other considerations apart, Mexico and the United States are constantly aware of each other's presence because they share an unfortified transcontinental boundary of 1500 miles which bisects the North American continent from the Atlantic to the Pacific. Mexico and the United States have developed side by side, and a major thread in the respective national histories has been their mutual influences over a long period. The border zone was originally hampered by being located a thousand miles from the populated heart of either nation and contacts between the two countries were sporadic, weak, and relatively unimportant.

Technology and Transportation Spark Changes

Technology and transportation, however, have increasingly changed that situation. Dry farming, irrigation, oil, burgeoning rail and highway networks, plus airways and modern shipping, have been profoundly instrumental in filling the previously unattractive border zones. This change has occurred both on the United

Presented at the President's Luncheon, March 10, 1954, during the International Meeting of The American Society of Mechanical Engineers, Mexico City, Mexico.

States and the Mexican sides; previous blanks on the map are now filled with growing numbers of people.

It is the people of Mexico as a whole who will determine its fate in the future. Their tastes, their health conditions, their levels of culture, their income, their capital, and their skills are all major determinants of what they can do with their natural resources to transform Mexico into the rich and happy nation toward which they are striving.

Mexico, Wartime Ally

Mexico contributed huge quantities of vital war materials to the United States during the years of the conflict between the Allies and the Axis powers in World War II. Weapons of war carried by the fighting men of our nation all included something of the mineral resources of Mexico and it is well to mention that mineral resources will have an important part in the future industrial development of Mexico. The increased production of such vital elements as graphite, iron, arsenic, zinc, copper, and silver furnishes one of the keys to higher living standards and national economic prosperity. They also reach across the border to create an atmosphere and a pattern of mutual co-operation so necessary in our modern world.

New President—New Administration

Mexico, like the United States, has spent 1953 getting used to a new President. Both of us are pleased with what we have seen. Adolfo Ruiz Cortines is a quiet civil servant of impeccable integrity and has well nigh transformed the Mexican government. His unprecedented leadership in government is succeeding. He has managed to retrench a wildly over-extended economy; he has pushed sound money policies, bridled inflation, organized tax reforms, and encouraged foreign investment. We learn that your truly great President has recently announced a record budget of nearly $600 million with ample provision for the upbuilding of transport, irrigation, power, and education, investment so necessary in your expanding economy. Tradewise, you now stand as the best customer of the United States in Latin America represented by some $600 million in purchases north of the Rio Grande. Mexico is not an agricultural country, a mining country, or an industrial country; therefore Mexico cannot specialize. It is a little of everything and its task is one of co-ordination, integrating all of its possibilities into a balanced economy. Mexico merges on two different cultures, the technology on the north and the artistic culture of the Latin countries. Culturally of a humanist philosophy, Mexico today is at work applying technology for humanist purposes. Your renowned Minister of Communications and Public Works, Architect Carlos Lazo, Jr., has planned many of Mexico's most arresting buildings, including your spectacular University campus. Señor Lazo, like his chief and your President, wants to help build a new and better life for his people. They are leaders in government who are supremely socially conscious, imaginative, courageous, and truly trusted in their work. They reflect the well-founded optimistic thinking going on in your midst today about your country's political and economic future. Your leaders are not in a hurry but they are not losing time; neither have they a desire for power except to serve their country honestly and well.

Your railways, air-transportation facilities, your communication systems are in the process of expansion and improvement, with the realization that the essential rights in a civilized society are the enjoyment of vital minimum necessities by means of sufficient production of material and spiritual wealth, whose ultimate objective is their use by the majorities but, at the same time, constantly appreciating that the concrete possibility of a fair distribution resides in a co-ordinated, ample, and efficient communication and transportation program and such communication is realized to be the instrument of social well-being. Mexico, with a population of 26 million people that is increasing at the staggering rate of three per cent per annum, is the third largest population in the Western Hemisphere.

Technical Training

American technicians have gone to Mexico in large numbers to impart American technical skill and at the same time, more and more Mexicans are coming to the United States to study engineering, medicine, dentistry, and so on. There are now more than one-thousand such students in our country. We are so short of technicians that to loan such technical assistance at this time is a real sacrifice for us and the proof of our genuine desire to be helpful to you. There is no desire except one of lending temporary assistance in an area so necessary during the formative period of your national industrial growth. Such aid is well understood when we realize that during the past decade your country has enjoyed an average annual rise in net production per capita of 4½ per cent.

In addition to more than doubling your national income, your present administration has caused to be made available millions of acres of new land which have been thrown open to agriculture. Thousands of miles of highways have been built and railways rebuilt, schools constructed in almost every village and town, mammoth irrigation dams thrown up, whole rivers turned from their courses, and new billions of kilowatt-hours generated. In all this vast effort on your part, we are glad to mention that the United States currently absorbs 80 per cent of your exports for which you take in return about 85 per cent of your imports from our country. Meanwhile your billion-dollar cattle business, which was ravaged by an epidemic of hoof-and-mouth disease, was rescued by the friendly co-operation of our Department of Agriculture which spent no less than $160 million for this purpose. Reference also can properly be made regarding the newest and possibly one of the richest sulphur deposits in the world which has just recently begun producing in the San Cristobal dome.

Past Decade Brings Many Changes

Since 1940 a transformation, hardly noticed, but due in large part to your friendly influence, has been operating throughout our territory nearest to your border. In a great arc along the Gulf of Mexico from Pensacola, Fla., in the east, through Mobile, Ala., Baton Rouge, La., Beaumont and Houston, to Corpus Christi, Texas, in the west, a new South has come into being. Urban and industrial, it has moved away from the agrarian past of the region. Statistics supply a dramatic indication of the magnitude of the movement. Between 1940 and 1950, while the population of the rest of the state re-

mained relatively stable, that of Mobile leaped upward by 64 per cent. In the same decade, Baton Rouge, from a city of 34,000, became one of 126,000. Beaumont and Corpus Christi have nearly doubled in size. Texas City and the Lake Charles district (of New Orleans) tripled. Houston added 212,000 to its 384,000 residents; and on the prairies rose the thriving new cities of Pasadena and Baytown, Texas. These places continue to grow, and every index of productivity and income is evidence of their capacity to expand. These exciting changes have supplied a dynamic part of the Gulf Coast country with the economic resources for resolving the ancient problems of the area: poverty, political corruption, and social inequality.

We are all Americans and therefore must do everything individually as well as collectively to protect the interests of America.

As engineers we pay our sincere tribute to the deserved excellence of your program involving the National University. This institution had 8000 students 15 years ago; now its new $50 million campus can accommodate about 30,000 and is typical of the vast advances that have been achieved in recent years.

The idea that Mexico lacked capital for its own development has been exploded by its leaders. What they lacked in the past was capital at work and this involved overcoming fear and substituting confidence. The change that has come over Mexico in recent years is cause for great rejoicing and is a tribute to the highest type of leadership. We find a proud, productive country. Old cities hum with new industries and shine in modern splendor. In cultural progress, also, the land has become outstanding. Nothing could symbolize more truly or hold a greater potential wealth of mutual confidence and co-operation than your possession of an institution of this sort where we can meet on equal terms and serve each other constructively and in the highest sense.

The American who gazes back on 1953 and sees evidence of improved techniques and better tools for tomorrow's job; of expanded production; and the resulting material benefits being widely distributed among the now 160 million of our country and the 26 million of yours, realizes that this is no accident but is the result of competent planning, earnest effort, and good administration which can be achieved only with the friendship and co-operation of our two countries as great neighbors.

Mexico remains and will remain distinctly Mexican. Modernization of agriculture, urbanization, industrialization, and other movements have begun substantially to change the face of the ancient area, but the times of change have not made of it a Spanish facsimile of the United States. Mexico is a friend and partner, not a satellite of the United States.

The Expanding Market for Electric Power

(Continued from page 486)

Internal-Combustion Practice

About 1¾ per cent of the total power produced was by internal-combustion engines in 1945, the last year for which separate data are available. The limited size of individual units and the fact that the modern high-pressure-temperature steam stations equal internal-combustion engines in efficiency precludes the likelihood of any significant change in the proportion of power produced by this type of equipment.

The internal-combustion or gas turbine is coming into use for rather special types of service. The largest unit in operation in the United States is of 5000-kw capacity and a 15,000-kw unit is being built. A 20,000-kw unit started operation in England in 1952. The largest unit (27,000 kw) of which the authors are aware is in Switzerland and started operation in 1949. There are many new problems concerned with successful operation of gas turbines and more experience is needed before we can expect much further increase in the size of units.

Nuclear Power

Satisfactory progress is being made in the development of means for the utilization of nuclear reactors for power production. Westinghouse Electric Corporation recently has been commissioned by the Atomic Energy Commission to build an atomic plant with a capacity of 60,000 kw.

The entire power industry as constituted today has been possible only through development of means for the transmission and distribution of electrical energy. Interconnection between the systems of contiguous power producers have made it possible to pool spare capacity. This definitely reduces the necessary over-all percentage of spares. It also permits operation of the most efficient equipment and relegation to stand-by status of the older generating units.

All major systems in the country are interconnected and it is now theoretically possible to generate power in Maine and deliver it to Southern California.

Transmission voltages have increased and today a line at 330,000 volts is in successful operation. Experiments are being carried on with even higher potentials.

New Fields for the Old Guard

Facts about the Old Guard Committee of the ASME and the work it is doing to aid the younger members of the Society

By W. A. Shoudy[1]

Secretary, Old Guard Committee of ASME

HELPING young engineers to bridge the gap between college and professional life and bringing them closer to the professional activities of their Society are two important aims of the Old Guard Committee of The American Society of Mechanical Engineers. Since its formation the Old Guard Committee has included in its program such specific aids to young engineers as student prizes, paying travel expenses of student-prize winners to annual meetings, student guests at annual meetings, student luncheons, sending Junior (Associate) delegates to Society meetings, and support of the National Junior Committee. Currently the Committee is exploring new ways in which it can help the younger members of the Society.

ASME Old Guard Committee

Carl F. Dietz, Chairman
Frederick D. Herbert, Chairman Emeritus
J. L. Kopf, Treasurer

E. G. Bailey	N. T. McKee
W. L. Betts	C. B. Peck
R. M. Gates	E. B. Ricketts
C. O. Gunther	J. W. Roe
S. M. Marshall	W. A. Shoudy

Executive Committee: Messrs. Dietz, Bailey, Gates, Gunther, and Shoudy

How It Started

The "Old Guard" consists of members who no longer have to pay dues to the Society. Members become dues-exempt when they have paid dues for 35 years (Student membership years not included) and in addition have reached the age of 65 or have retired from active work.

In 1937 Maurice Hoopes found himself dues-exempt and wrote the Society saying that he felt that he had not yet fulfilled his many obligations. He wished to continue paying the amount of his dues and suggested that the money be used for nonbudgeted activities. Out of this suggestion came the "Dues-Exempt Members Contributions Committee." The Committee sent out an appeal for money in 1937 and collected sufficient funds to start its activities. It was soon known as the "Old Guard Committee" and that became its official name. The first chairman was Harte Cooke who continued with the Committee until his untimely death. He was succeeded by Frederick D. Herbert who gave unselfishly of his time until health forced him to retire in 1953.

In view of the increasing enrollment of Junior (Associate) members it was felt that no better use could be made of the funds of the Committee than by bringing these young members closer to the Society's activities. As a first step selected men were sent to the annual meetings with expenses paid. As voluntary contributions increased more men were helped and the activities broadened.

Financing the Program

The annual cost of the Old Guard Committee's program for helping young engineers has been under $3500. No campaign for funds has ever been made but when funds are growing low, a letter is sent to dues-exempt members telling of the activities of the Committee and a follow-up has never been necessary. No request for funds has been made since November, 1952. From that appeal 258 contributions totaling $3550 were received. Other contributions increased the total to $4150.

Contributions have ranged from $10 to $100. In 1948 a bequest of $5000 was received from Mrs. James A. Seymour, widow of an ASME Honorary Member, to establish the Seymour Memorial Fund. Only the interest from this Fund is being used by the Committee. The current treasurer of the Society is automatically the treasurer of this Committee and is custodian of the Committee funds. All disbursements are authorized by the Committee.

There are now over 1700 dues-exempt members of the Society and the number is increasing each year. Some are affluent, some are not. Many are still active in Society affairs. All have acknowledged the value of the Society to them by their long years of membership.

A Challenge to the Old Guard

The present members of the Old Guard started their professional life under conditions that no longer exist. Million-dollar corporations were relatively few then and the number of engineers employed was small. Most engineers knew the management, at least by sight, and many had the privilege of working directly under a man of experience and mature judgment from whom they absorbed much of the know-how. Today many a young engineer is one of a pool supervised by men not much older than himself. He learns little of "the why" things are done as they are and has little contact with men of wide experience.

Each year about 3000 student members are admitted to the Society but within two years, one half have dropped out. Some drop out because they find themselves in another field but probably most of them because

[1] Consulting Engineer, New York, N. Y. Fellow ASME.

they feel that they have received little help. Over 18,000 of our total membership—45 per cent—are 32 years old or younger. This is more than the 14,000 in the Member grade.

Maintaining Junior Interest

The Old Guard Committee has given considerable thought to the problem of maintaining Junior interest. The Committee has been teaching the value of membership to a limited number by defraying their expenses for travel to some of the Society's meetings. The Committee will continue this practice but it can reach only a very small percentage of the younger members. The extent of any program aimed at maintaining Junior interest in the Society naturally depends on the funds available. The committee believes that these funds will be forthcoming if a more extended program is developed.

New Tasks for the Old Guard

In 1944 MECHANICAL ENGINEERING printed three papers by W. J. King which have been reprinted several times under the title, "The Unwritten Laws of Engineering." These papers are fundamental and should be read by every man entering the profession. The Engineers' Council for Professional Development has published a number of pamphlets which bridge the gap between college and professional life but none is widely distributed. Last year F. S. Blackall, jr., then president of ASME, suggested to the Council that Professor King's papers should be more widely distributed, and $1000 was appropriated for this purpose. The Honorary Chairman of each student branch has been advised that a copy will be sent to any student member on request. This practice should be continued. It may be a task for the Old Guard.

It is not unnatural to be a bit tired of study after four years of intensive work. The wish to study returns as new problems arise. How to hold and advance in a job is a new problem to many graduates and the necessity to study it is not always apparent. The Old Guard Committee can at least point out the need and where the source material can be found.

It is hoped that this year a letter from the Old Guard can be sent to each of the 3000 student members who will join the Society. This will be a letter of welcome but most of all an offer to help. With this letter the Committee will include at least a list of ECPD publications. With more money the Committee could include a pamphlet to awaken interest in further study. The next step though "in the works" will take time to organize. The Committee hopes to enlist a few members in each of the eight Regions who will welcome and answer letters from the younger Junior (Associate) members and sit down and talk with them when it is geographically possible.

These are activities which can be seen in the immediate future. As funds grow, others can be added. Undergraduate scholarships are now generally available but there is a growing interest in graduate study. Because of military service the graduating age is older and some students have taken on household expenses. Many who find it difficult to pay cash for graduate tuition will gladly repay a loan. These loans can become an increasing revolving fund of growing usefulness.

The Old Guard Committee believes that these are essential, in fact necessary, activities if professional standards are to be maintained. These standards can be learned only in part by the written word; they must be handed down from generation to generation. The Committee is not primarily interested in increased membership but it is interested in maintaining the high professional standards that have grown over the past seventy-four years.

Men's Creative Production Rate

STUDIES have shown that the mean age at which outstanding creative thinkers have done their best (or almost their best) work is not a fixed entity in the sense that it remains unchanged under any and all circumstances. On the contrary, mean age at time of achievement varies with such factors as century of birth, the age at which the creative workers start their careers, the quality of the output under consideration, the type of creative output, and perhaps a number of other variables, according to a study presented by Harvey C. Lehman, professor of psychology at Ohio University, Athens, Ohio. His study, published in *The Scientific Monthly*, May, 1954, deals not primarily with mean age at time of achievement but with creative production rate.

Professor Lehman points out that if we in the U. S. A. desire to use our creative manpower to best advantage and, thus, to avoid wastage of our most precious human material, we should find out all that we possibly can about the conditions that give rise to creative achievement of a high order. If, for example, it were found that the eminent thinkers of some few countries, or even of only one country, have displayed more creative stamina than have the eminent thinkers of other countries, it might then be possible by means of careful follow-up studies to obtain some hint on how this very enviable state of affairs was brought about.

In making this study, generalized curves were drawn for the various national groups setting forth age differences in creative production rate. These depict for several national groups their creative production rate in the various sciences and in mathematics. On the whole it may be said that, for as recent a date as can be studied effectively, such age differences as exist are minor ones and that the decrement in creative production rate subsequent to ages 30 to 39 is about as rapid in one country as in any other.

These data do not mean that older men, as compared with persons of ages 30 to 39, are intellectually less competent to do creative work of a high order. Whatever the causes of growth and decline, it is clear that the genius does not function equally well throughout the years of adulthood.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., *Associate Editor*

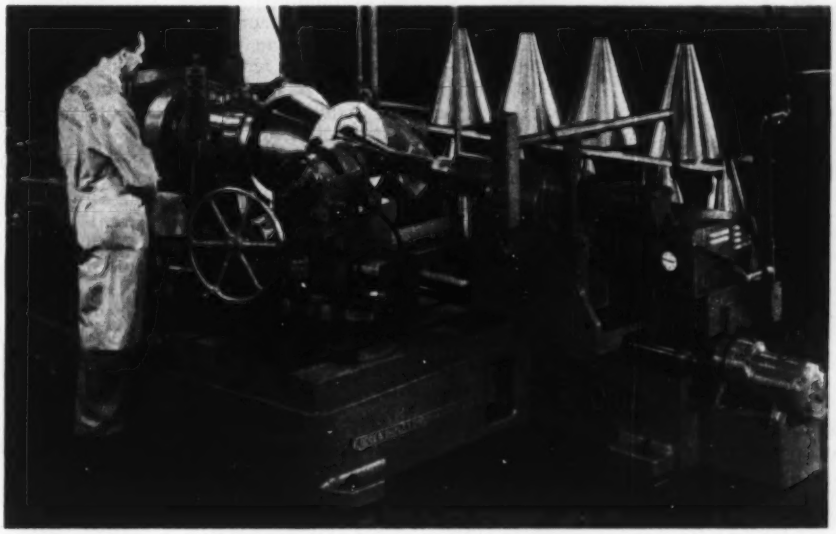


Fig. 1 No. 40 Floturn lathe is shown forming an exhaust cone for an aircraft gas-turbine engine. Note the finished exhaust cones in the background.

Cold-Forming Metal

A NEW metal-forming technique that is said to be fast, low-cost, and to save costly critical material has been announced by The Lodge & Shipley Company, Cincinnati, Ohio. Called the Floturn process, the method forms metal with great pressure applied scientifically to cause the metal to flow in a cold state. Using a hardened and polished roller, the pressure is applied in a continuous spiral manner, gradually and accurately flowing a metal blank to the shape of a mandrel.

Conical, cylindrical, combinations of those two, and other complex shapes can be formed by the method. The process starts with a simple flat blank, machined blank, machined forging, drawn cup, wrapped and welded cylinder, or a centrifugal casting. In many cases, with a single pass, the part can be produced directly to finished dimensions. In other cases, where extreme precision is necessary, 0.015 to 0.020 in. may be left for machining.

The method differs basically from the centuries-old spinning method. In spinning, a blank considerably larger than the finished piece is used. Using moderate pressure, the blank is merely folded in a circular manner, using a hard tool against a round mold. This manual art requires a craftsman of considerable skill and experience. The parts produced lack uniformity; production is low.

With the new process, the diameter of the blank is exactly that of the finished part. Thickness is heavier than required in the finished wall. The additional metal flows into the extended shape. The machine controls the operations; no particular skill is required of the operator. All pieces are uniform; dimensions can be held to 0.002 in. Production is high. Instead of a cutting tool, a 68 to 70 Rockwell C hardened roller is used to form the various shapes.

The process already has been tested widely and used in jet aircraft-engine production where an important time and moneysaving application is seen. New alloys, including many considered hard to machine, are easily worked by the method. Among metals successfully formed are: All 300 and 400 series stainless steels, Timken 16-25-6 and 17-225, Haynes Multimet, Universal Cyclops Uniloy 19-9, Inconel and Inconel X, Monel and

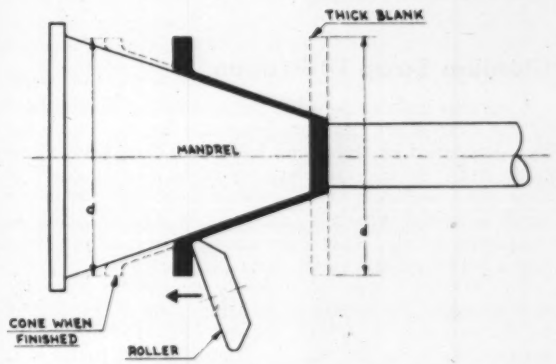


Fig. 2 Principle of operation of new cold-forming process

Fig. 3 Roll-forming a jet-engine exhaust cone by the Floturn process. Diameter of blank does not change as roller cold-flows metal blank to shape of mandrel on lathe spindle. Flange can be left at open end of cone, by stopping the roll carriage.

K-Monel, Titanium T1-140-A, copper and aluminum, as well as mild steel.

The No. 40 × 24-in. Floturn lathe handles work 42 in. in diam and 24 in. long. The No. 40 × 50-in. lathe handles work 42 in. in diam and 50 in. long. Work of larger dimensions may be worked on special equipment. Blanks of the harder metals may be worked up to $^{5}/_{16}$ in. in thickness. Those of the softer metals may be worked up to $^{1}/_{2}$ in. in thickness.

The method, it was pointed out, actually increases the strength and hardness of the metal worked. In direct contrast to the stresses developed in, for example, deep drawing, Floturn has a beneficial effect similar to cold-rolling on the granular structure of the metal.

For example, in working 302 stainless steel, tests show that the new process increased tensile strength as much as 100 per cent. Even after stress-relieving, the increase still amounted to about 40 per cent.

To illustrate savings in material, the following comparison of a part produced by forging and machining versus a part produced by Floturn was cited by the company.

A finished workpiece, weighing 50 lb, started as a forging with a weight of 369 lb. The forging cost approximately $276.75. For the same finished part, the Floturn blank weighs 65 lb, costs only $48.75. The savings in material alone are $228.00 or 82$^{1}/_{2}$ per cent.

Titanium Scrap Utilization

A PROCESS making possible the utilization of virtually all the scrap-sheet titanium generated by the plant has been developed by the Glenn L. Martin Company, Baltimore, Md. By resistance spot-welding a thick stack of these sheets submerged in liquid, a solid ingot of virgin metal is formed which is said to be at least as strong as the parent metal. This ingot can then be machined into scarce hardware or aircraft parts.

The Martin process is basically unchanged from the normal method of resistance welding. By adding a tank to the machine in which the two electrodes and the material to be welded meet in liquid, it was found that he capacity of the machines could be increased up to sixfold. In the past, when metal was stacked more than an inch thick, it would seriously oxidize and become so hot as to cause metal expulsion and warpage. By performing the welding cycle under the cooling effect of a liquid, the thickness of the weldable laminate has been increased to 6 in. for titanium and 3 in. for stainless steel. Research is presently under way to increase these figures.

The actual mechanics of the Martin process are simple. In one case, 85 sheets of 0.064-in. titanium, with two sheets of 0.092-in. titanium on top and bottom were resistance spot-welded in liquid.

This was briefly the procedure: The sheets were deoxidized in an aqueous solution of 2 per cent hydrofluoric acid and 10 per cent nitric acid. A 400-Sciaky three-phase welding machine was used with Mallory 3 electrodes, 2$^{1}/_{2}$ in. in diam and with a radius of approximately 20 in. The cooling tank was 24 × 24 × 8 in. The bottom electrode protruded into the bottom of the tank and the top electrode was just submerged in the liquid. The control settings to produce the 6-in. laminate were as follows: Weld, 69 per cent; weld vernier, 43 per cent; pressure, constant high 19,500 lb; weld heat, 6 cycles; cool time, 2 cycles; weld time, 15 sec on multiple impulses.

To test the strength of the laminate formed, Martin laboratories were supplied with a standard ASTM tensile-test specimen machined from the nugget. The following is a comparison between the minimum specifications for the parent material and the results obtained with the Martin nugget:

	Parent material AMS 4901 Ti sheet RC 70,000	Welded test piece
Tensile strength	80,000	92,000
Yield strength	70,000	73,700
Elongation	15 per cent min	17 per cent

Applications of the new process are many. Scarce titanium hardware, such as bolts and pins, can be machined from the weld nugget formed of titanium scrap as

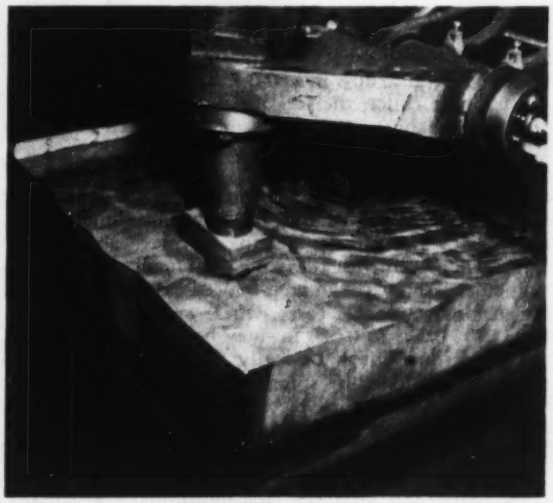


Fig. 4 Close-up of tank constructed by Glenn L. Martin Company to develop the new resistance spot-welding process. Visible is the lower electrode in the bottom of the tank, a stack of sheet stainless steel, and the upper electrode. Through use of this liquid coolant it is possible to weld sheets of steel in thicknesses up to 3 in. and titanium in thicknesses up to 6 in.

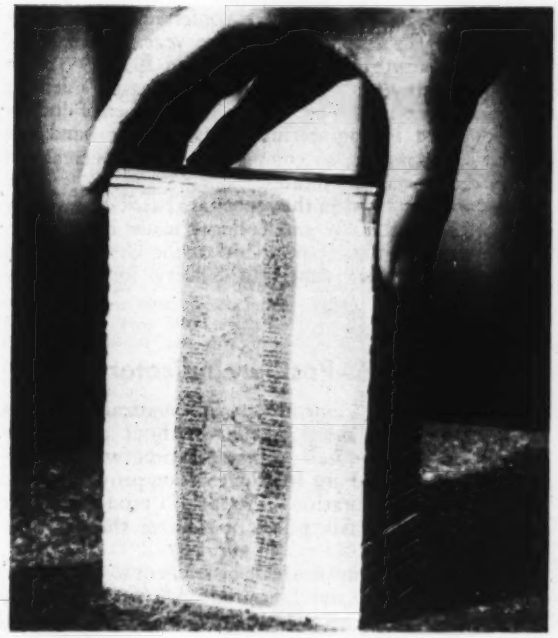


Fig. 5 Shown are 89 sheets of titanium that have been resistance spot-welded in solution to form a solid stack 6 in. thick. This process, utilizing a liquid coolant, increases capacity of available resistance-welding equipment sixfold.

can aircraft parts. Other uses will be found in the manufacture of laminated wing sections and, perhaps, even whole wings. Tooling also can be speeded up through the use of this new process in fabricating built-up tools with laminates of varying size.

Engineering-College Enrollment

ENGINEERING-COLLEGE enrollment has increased for the second consecutive year—after successive annual declines from a post-World War II high of 244,390 in 1947 to a post-World War II low of 147,694 in 1951, according to a report in *The Journal of Engineering Education*, February, 1954, by Henry H. Armsby and William A. Jaracz of the U. S. Office of Education. The 171,832 students currently enrolled in engineering schools accredited by the Engineers' Council for Professional Development constitute an increase of 8.4 per cent over the number enrolled in the fall of 1952. This is much larger than the 4.8 per cent increase in total enrollment, and the 3.3 per cent increase in male enrollment, in all higher educational institutions. The latter comparison is perhaps the more valid one, inasmuch as engineering enrollment consists preponderantly (99.5 per cent) of men students. This fall's increase of 8.4 per cent constitutes, furthermore, an increase in the rate of increase in total engineering enrollment, in view of the fact that the increase from 1951 to 1952 had been 7.3 per cent.

Engineering Schools Gain

A similar situation prevails in the case of new students. The gains experienced by engineering schools are considerably in excess of those for all higher educational institutions, the figures being 14.5 and 6.5 per cent, respectively. The 1953 freshman class of 52,482 students is the third largest ever to enter the engineering schools. The size of the enrollment figure of new engineering students for this fall, as contrasted with the larger figures for 1946 and 1947, gains in significance when one considers the circumstances prevailing then and now. The so-called enrollment "bulge" immediately following World War II was the result largely of the materializing of a deferred demand for education on the part of a significant proportion of the population of college age, a factor which has no counterpart in current enrollment behavior.

Although a larger proportion of young people are entering college, the dimensions of this increase are not such as to explain the considerable increase in freshmen engineering students. The explanation, the report states, must be found in the relatively stronger attraction which engineering disciplines have had for new students during the course of the past few years. This fall 9.2 per cent of all freshmen were enrolled in engineering schools as compared with 8.5 per cent last fall, 7.2 per cent in 1951, and 5.7 per cent in 1950. Many considerations of course underlie the choice by new students of engineering disciplines in preference to others. The ever-increasing impact of mechanization and science on our civilization, to which the young are exposed at every hand, has, in a general way, a considerable effect. More specific factors are, however, to be found in the increased demand, widely publicized, for highly remunerated technical and scientific personnel; the opportunity for military-reserve training with attendant commissions upon graduation; and the fact that deferment of military service until the completion of college training appears to be socially more palatable in the case of scientific and technical training.

Engineering Graduates to Increase in 1956-1957

The large number of freshmen engineering students this fall and last will undoubtedly be reflected in an increase in the number of engineering graduates in 1956 and 1957, assuming a stable rate of attrition. It is estimated that last year's entering class will yield 26,000 graduates in 1956, and this year's 30,000 in 1957. The outlook for the two intervening years is not nearly as bright, the estimates being 17,000 and 20,000 for 1954 and 1955, respectively. The small number of engineers who are expected to graduate during these latter two years, the result largely of small entering classes in 1950 and 1951, is likely to accentuate the acute shortage of civilian engineers in the years immediately ahead.

Undergraduate Engineering Students

The number of undergraduate engineering students has also, as is the case with total engineering enrollment, increased for the second consecutive year. The 150,426 enrolled in the fall of 1953 represent an increase of 8.9 per cent over the previous fall's enrollment. In view of the fact that the increase from 1951 to 1952 was 7.6 per cent, the 8.9 figure constitutes an increasing rate of increase.

The undergraduate enrollment is distributed by level as follows: Freshmen, 34.9 per cent; sophomores, 21.9 per cent; juniors, 15.9 per cent; and seniors, 14.5 per cent. Approximately 1.6 per cent are fifth-year students pur-

suing 5-year programs, and the remaining 11.2 per cent are part-time and evening students. The number of students in this latter category declined by 2.3 per cent, after registering successive annual gains from 1950 through 1952.

About 55.3 per cent of all undergraduate engineering students are enrolled in three curricula: Mechanical (20.9 per cent), electrical (20.5 per cent), and civil (13.9 per cent). The corresponding figures for 1952 were 55.2, 21.2, 19.3, and 14.7, respectively. This fall 86 schools reported unclassified students, as compared with 92 last fall, 84 in 1951, and 82 in 1950.

The number of male students upon whom undergraduate engineering degrees were conferred in 1952–1953 is 20.3 per cent smaller than in the previous year. This compares with a decline of 11.5 per cent in all first degrees conferred on male students in all institutions.

Of all first degrees granted to men students, 10.8 per cent were in engineering. The proportion was 11.9 per cent in 1951–52.

The distribution of first degrees among the three principal engineering curricula were as follows: Mechanical, 5284; electrical, 4415; and civil, 4070. These three fields accounted for 24.4, 20.4, and 18.8 per cent of all engineering first degrees, respectively. Fewer degrees were conferred in each of these fields in 1952–1953 than in 1951–1952, the declines being 22.6 per cent for mechanical, 24.9 per cent for electrical, and 17.2 per cent for civil.

Graduate Enrollment Increase Continues

The increase in graduate enrollment continues unabated. In the fall of 1953, 5.7 per cent more students were enrolled for the master's or other predoctoral degree than in 1952. A similar increase was registered from 1951 to 1952, namely, 5.9 per cent. The number of students enrolled for doctorates increased 2.4 per cent. The increase from 1951 to 1952 was 1.9 per cent. About 56.1 per cent of the students working toward the master's degree are evening students, as compared with 57.4 per cent for last fall. A considerably smaller proportion (23.4 per cent) of students working for doctorates, on the other hand, are evening students. The figure for last year was 22.8 per cent.

The increase in the number of graduate students reflects the demand by industry for individuals with advanced training in engineering. This is especially evident when one considers the high proportion of the candidates for master's degrees who are enrolled as evening students. The majority of these are undoubtedly employed engineers who recognize the necessity of advanced training for bettering their understanding of the more complex engineering processes which are constantly being developed.

While the number of graduate students in engineering has increased, they represent a smaller proportion (12.5 per cent) of total engineering students. The figure for 1952 was 12.8 per cent, and for 1951, 13.1 per cent. The proportion for the college population as a whole is about 10 per cent.

About 31.4 per cent of all graduate engineering students are taking training in electrical engineering, 17.3 per cent in mechanical, and 11.3 per cent in chemical. The corresponding figures for last year were 30.2, 17.0, and 11.4 per cent, respectively.

The number of master's degrees conferred in engineering declined for the second consecutive year. There were 9.8 per cent fewer degrees conferred in 1952–1953 than in the previous year. The decline in all master's degrees conferred was only 4.0 per cent. The number of doctorates conferred in engineering, on the other hand, increased 1.0 per cent, as compared with an increase of 8.1 per cent for all doctorates.

The data contained in the report are based on a survey of engineering schools and colleges made in October, 1953, under the joint sponsorship of the U. S. Office of Education and The American Society for Engineering Education.

Aircraft Ground-Position Indicator

An aircraft instrument that automatically gives a pilot his latitude and longitude without any air-to-ground or ground-to-air communication was demonstrated recently by Ford Instrument Company, Division of The Sperry Corporation. Already in production, the device promises to free pilots of most of their navigational problems.

The full military name of the instrument is "The Computer Set, Latitude and Longitude AN/ASN-6," often referred to as a "Ground Position Indicator." It was developed by Ford Instrument Company under the auspices of the U. S. Air Force in conjunction with the Communications and Navigation Laboratory of the Wright Air Development Center.

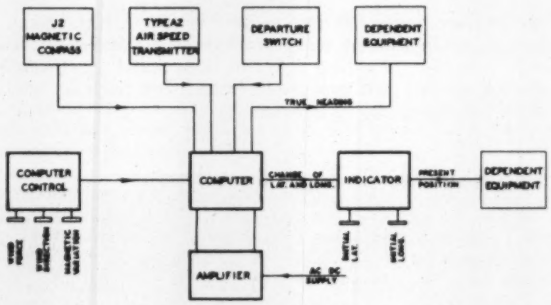


Fig. 6 Arrangement of four major units—indicator, computer control, computer, and amplifier—of the computer set.

Computer Set Consists of Four Boxes

The computer set weighs 45 lb and occupies a volume of 1.3 cu ft. The set consists of an indicator, computer control, computer, and amplifier.

Into the computer control the pilot dials his wind speed and direction, and magnetic variation. Into the indicator the pilot sets his take-off latitude and longitude.

From the compass and air-speed indicator, which are standard equipment in airplanes, the computer receives true air-speed and magnetic heading. Once the plane is airborne, the computer continuously calculates and the indicator continuously displays the airplane's changing latitude and longitude.

The equipment is especially valuable for the military pilot since it does not need ground signals for its functioning. Nor does it send out signals, which an enemy

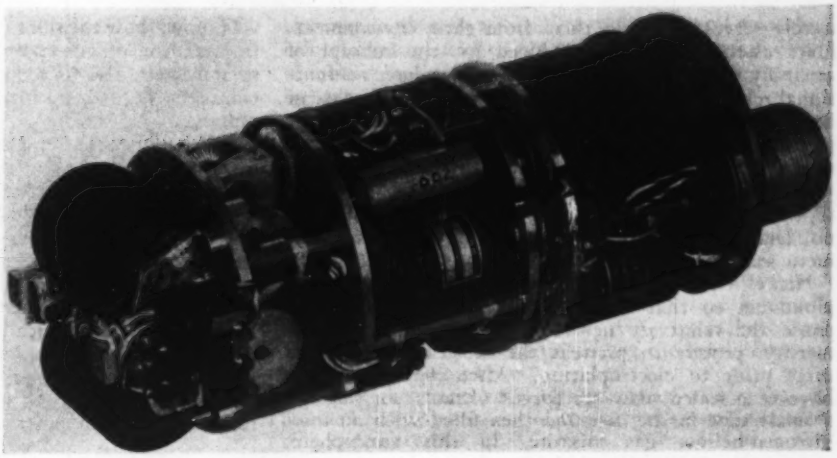


Fig. 7 In the design of the indicator for panel mounting, some of the smallest gears and differentials ever designed plus miniaturized synchro units and Ford Instrument servomotors are mounted on circular plate assemblies. More than 500 parts are crammed into a cylindrical volume a little more than 8 in. long and 3 in. in diam. The indicator case is hermetically sealed and filled with a nitrogen-helium gas mixture.

could backtrack to locate the airplane. In addition, the jet pilot is so occupied flying his airplane, searching the skies for enemy aircraft, and maneuvering to avoid anti-aircraft fire, that he has little time left over for navigating.

The computer set can be valuable to the commercial pilot who would not have to depend on navigation by radio beam, which can develop static, bend, or black-out.

The instrument, it is believed, will last the life of the aircraft. While the electron tubes in the amplifier unit are accessible so that they may be changed at regular maintenance intervals, the rest of the mechanism is not accessible. In fact, the three electromechanical units are hermetically sealed and require no lubrication or servicing. Sealed prototypes of this instrument have been operating for two years without the shells ever having been opened.

Design Problems

The design problems encountered were unique. For example, to overcome the handicap of size and weight, Ford has started a program of extreme miniaturization.

A 10-watt servomotor is used in larger computers, while a $^1/_8$-watt servomotor is used in the computer set ASN-6. Pounds have been reduced to a few ounces. One of the mechanical components basic to this type of computer is the differential, which adds or subtracts and transmits values by shaft rotation. The gears are designed to operate with literally "no" backlash which would introduce mathematical error. The differential used in this navigation computer has been reduced to about the size of a paper clip. A $1^1/_2$-in. disk mechanical integrator was designed to integrate rates with respect to time producing finite changes in values.

In assembly, these small components literally hang on each other and are covered by an exoskeleton that

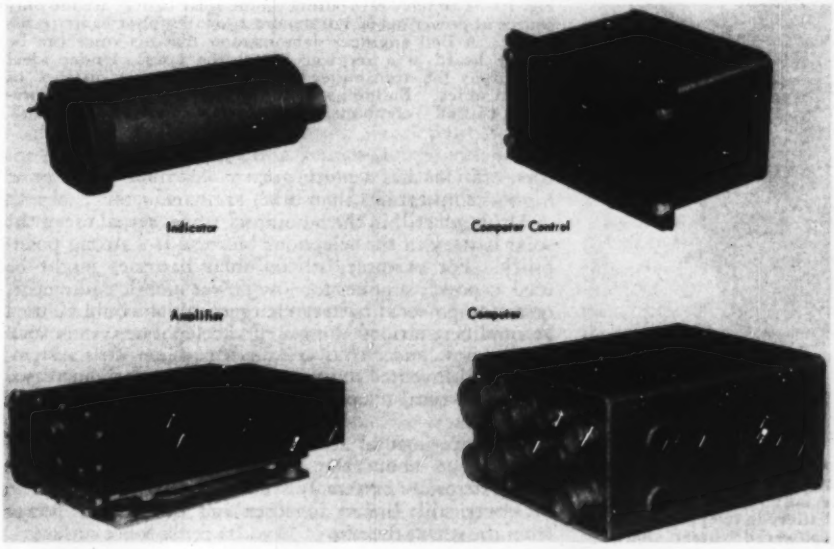


Fig. 8 These units of computer set make up an air-borne self-contained navigational system weighing only 45 lb and occupying 1.3 cu ft. The indicator and computer control are mounted close to the pilot or navigator. The amplifier and computer units of the set may be mounted remotely.

merely serves to shield them from their environment. Plate assemblies were abandoned for the concept of assembly plate whereon parts which may have no functional relationship are hung to save weight and space of individual mounting. Amplifiers for powering the servomotors were remoted and collected in a chassis where heat could easily be carried away by blowers.

The cases and much of the mechanism were fabricated of lightweight aluminum alloy. But aluminum does not lend itself readily to the soldering needed for hermetic sealing.

Nickel was found to be the best material to plate aluminum so that it would take solder. Ford also chose the relatively new and controversial zinc-immersion process to pretreat the fabricated aluminum cases prior to electroplating. After the components have been sealed, they are purged of moist air through a small tube in the case and then filled with an inert nitrogen-helium gas mixture. In this atmosphere, even the most highly polished surfaces will never corrode. The seal at case edges and screw fittings is so tight that no gas will escape even at an altitude of 50,000 ft. No damage was noted to the mechanism after exposure to driven salt spray for 50 hr. The basic elements of this computer are mechanical parts fitted together with such accuracy that no lost motion can be present to introduce inaccuracies in computation. Yet allowance has been made for the natural elasticity of metals. The computer will operate satisfactorily at a low temperature of —65 deg or at a high of 71 C.

Experimental Solar Battery

USEFUL amounts of the sun's energy have been converted directly and efficiently into electricity by a solar battery demonstrated recently at Bell Telephone Laboratories, Murray Hill, N. J.

With a simple apparatus, made of strips of silicon, it was shown how the sun's rays could be used to power the transmission of voices over the telephone wires. The solar battery also used energy from the sun to power a transistor radio transmitter carrying both speech and music.

Bell Laboratories reported that it was able to achieve a 6 per cent efficiency in converting sunlight directly into electricity. The efficiency of other photoelectric devices has never been rated higher than 1 per cent.

With improved techniques, Bell scientists said they expected to increase this efficiency substantially. Nothing is consumed or destroyed in the energy-conversion process and there are no moving parts, so the Bell solar battery should theoretically last indefinitely.

The specially prepared silicon used is obtained originally from common sand, one of the world's most abundant materials. Silicon is a semiconductor, chemically related to germanium, the material used in most transistors. Silicon has a much greater electronic stability at higher temperatures than other semiconductors.

Fig. 10 The sun's rays falling on the solar battery are the only source of power needed to operate a small mobile radio transmitter. A Bell engineer demonstrates that his voice can be clearly heard at a receiver across the lawn. Under ideal conditions the transmitter can operate over a distance of several miles. Buildings of the Murray Hill, N. J., Laboratories of Bell Telephone are also visible in the background.

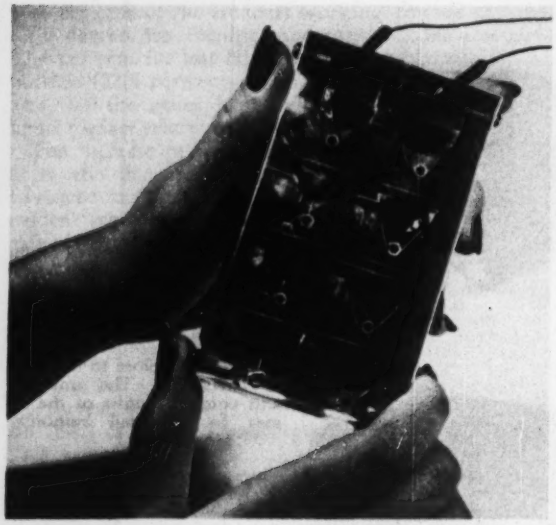


Fig. 9 Experimental solar battery for converting useful amounts of the sun's energy directly and efficiently into electricity. Composed of strips of specially prepared silicon, the Bell System envisions uses for the battery in telephony, mobile radio-telephone systems, and sun-powered battery chargers.

Although still in the laboratory stage, actual use of the solar battery in the telephone business is a strong possibility. For example, silicon solar batteries might be used as power supplies for low-power mobile equipment, or as sun-powered battery chargers which could be used at amplifier stations along a rural telephone system such as that now under trial at Americus, Ga. This system, using Bell-invented transistors, points to greatly increased service on rural telephone lines without the addition of new wires.

The experimental solar battery uses strips of wafer-thin silicon about the size of common razor blades. These strips are extremely sensitive to light. They can be electrically linked together and can deliver power from the sun at the rate of 50 watts per sq yd of surface.

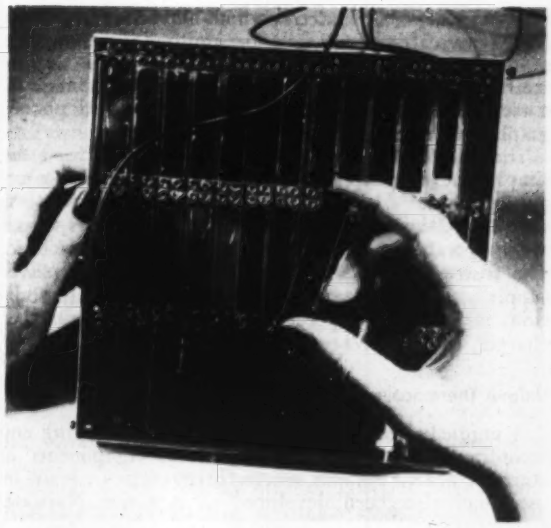


Fig. 11 Solar battery can deliver power from sunlight at the rate of 50 watts per sq yd of surface. Specially prepared silicon strips the size of common razor blades are linked in series in the device shown. The hand holds an individual strip.

Key to the new technique for producing these silicon devices is the controlled introduction of a foreign element into a microscopic layer near the surface of a thin slice of silicon.

Treatment under gas at high temperatures permits the introduction of minute traces of impurities into the atomic structure at the surface of the silicon. Introduced at a precise rate and under carefully controlled conditions, the impurities reach a depth of less than 0.0001 in. This is essentially a "P-N junction," which is the heart of all these devices and which, when built into a germanium single crystal, is the basis for the junction transistor, also invented at Bell Laboratories.

Atomic-Energy Developments

MANY new developments in the field of atomic energy have been disclosed recently. There seems to be an endless procession of atomic-energy reports, reports on nuclear-power studies, instrument developments, and the like. All are interesting and should provide useful information for mechanical engineers and at the same time keep them abreast of the great activity of the atomic-energy program in the U. S.

Atomic-Energy Report

Among the numerous developments in the atomic-energy program of the United States during the six months covered by the fifteenth semiannual report of the Atomic Energy Commission to Congress was the start of a project for the design and construction of the nation's first full-scale industrial nuclear power plant. This decision was made against a background of continued progress in reactor development.

As a basis for further civil-defense planning, the health and safety activities of the technical co-operation program in which the United States, Canada, and the United Kingdom joined in 1948, were enlarged to include information relating to blast, heat, and radiation effects of atomic explosions on human beings and their environment.

Continued emphasis was placed on the discovery, development, and exploitation of new sources of raw materials and the building of new plants to ready these materials for the Commission's manufacturing facilities which continue to expand. Raw-materials sources, both domestic and foreign, increased and there are now nine ore-processing centers in the United States.

The new feed-materials plant at Fernald, Ohio, was completed and some expansion of these facilities is already under way. Throughout the AEC operations new plants came into production, raising the level of output and decreasing unit costs.

During this period the AEC construction program accounted for 3.35 per cent of the nation's total construction expenditures.

In connection with research and development in the weapons program, preparations are under way for an experimental test series at the Pacific Proving Ground. Recent technical developments in the production of weapons and weapon components made it possible to cancel construction of the Spoon River explosives, resulting in a substantial saving.

While continuing the necessary study of means of protecting men against the harmful effects of radiation, the Commission gave increased emphasis to finding new and improved methods of applying nuclear radiation in the treatment of human disease.

Research continued vigorously with strong emphasis on studies of the fundamental nature of matter. Among new tools that became available for this and other research work are a new small "water-boiler" reactor at Livermore and two new electronic computers, the ADIDAC at Argonne and the ORACLE at Oak Ridge.

While the Commission was moving toward its decision to build a full-scale power reactor, it enlarged the program of participation by industrial study teams exploring avenues to industrial power other than the chosen pressurized-water design. Work currently going on in other phases of the reactor-development program, including constant efforts to improve the performance characteristics of the production reactors at Hanford and Savannah and continued developmental work being done on naval and aircraft-propulsion systems, also will contribute eventually to the development of industrial nuclear power.

Power-Reactor Studies

In MECHANICAL ENGINEERING, May, 1954, page 442, it was briefly reported that the AEC has approved separate study agreements with American Machine and Foundry Company and The Babcock and Wilcox Company, of New York, N. Y., and Bendix Aviation Corporation, of Detroit, Mich., looking toward the practical application of atomic power and its by-products.

Specifically, the B&W study will concentrate on the design, development, and manufacture of equipment necessary to the operation of nuclear power plants.

Bendix will deal with the future of atomic power and by-products, anticipating the development of new reactor designs and the discovery of new uses for radioactive isotopes or fission products.

AMF will make a study of machines and equipment

associated with nuclear power plants and will explore the feasibility of developing low-power reactors for industrial research. The three new projects will run for one year, with all costs borne by the companies.

In addition, a proposal for the Dow Chemical Company-Detroit Edison Company industrial study group to begin a new phase of nuclear-power investigations involving actual experiments and preliminary engineering has been approved by the Atomic Energy Commission. The Dow-Detroit Edison group includes 26 associated firms or groups of firms which have been studying nuclear-power technology since the beginning of the AEC's Industrial Participation Program in 1951.

Under the new agreement the Dow-Detroit Edison group will spend an estimated $2,300,000 on a detailed program of research and development on a breeder reactor for the generation of electric power and other products, and on related equipment and processes. Most of this sum will be spent in industry-owned research facilities. However, when specific research projects can best be carried out in the AEC's specialized facilities this may be done at the group's expense if the AEC finds that it is feasible and no AEC project has higher priority. The group may spend about $300,000 on such work.

Where the investigations of the group require work which is of direct interest to the AEC and forms part of its approved program, the expense of the project will be borne by the AEC. The cost of work within this category is estimated at about $300,000.

Portable X-Ray Unit

A small, inexpensive, and portable x-ray unit which has potential uses in medicine and industry has been developed by scientists at Argonne National Laboratory of the Atomic Energy Commission and is being tested as a diagnostic unit.

The active component of the instrument is a tiny particle of thulium which has been made radioactive in the heavy-water nuclear reactor at Argonne. Thulium is an extremely rare material which heretofore has found little practical application. The thulium is mounted in a source holder and shield equipped with a shutter mechanism in order that x-ray photographs may be made. The shutter is operated by a standard photographic cable release.

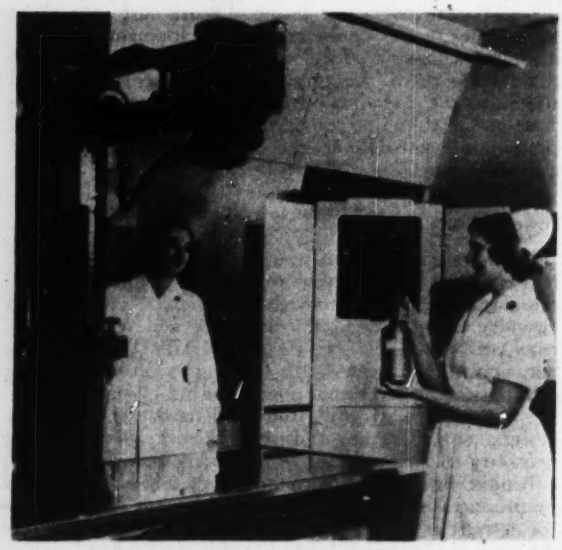


Fig. 12 Nurse at right holds portable x-ray unit. Its size may be compared to that of standard x-ray machine at left.

The development may meet the long-time need for simple, cheap, and portable equipment for making x-ray photographs. Although the entire unit weighs less than 10 lb, the radioactive thulium provides rays which are comparable in energy to a 100,000-volt x-ray machine. The instrument does not require an electrical power supply as does conventional x-ray equipment. In addition, it is quite inexpensive. Exclusive of irradiation charges, the total cost of the first model was $40.

Unique Thermocouple

A uniquely designed thermocouple for measuring and recording the temperatures of various components of complex heated systems where thermometers cannot be used has also been developed at Argonne National Laboratory.

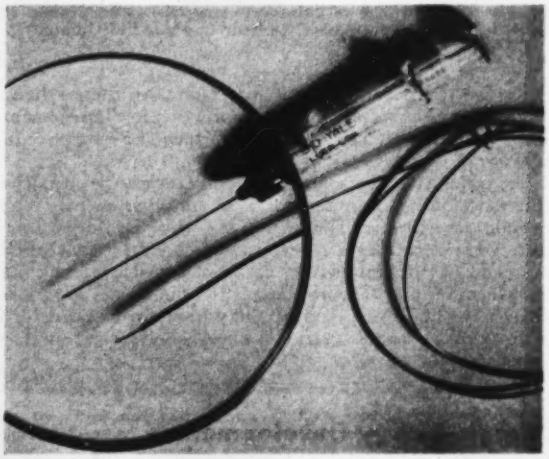


Fig. 13 Comparison of a thermocouple, developed at Argonne, to a standard hypodermic needle. The magnified portion shows the lead end of a 0.40-in-OD inconel thermocouple tube into which a 0.015-in. constantan wire has been inserted through its entire length. It is compared to a standard hypodermic needle having an OD of approximately 0.025 in.

The new thermocouple makes possible temperature measurements inside the fuel elements of operating nuclear reactors. This is possible because the new thermocouple is only slightly thicker than a standard hypodermic needle. Because of its thinness, flexibility, and ruggedness it can be threaded through small and winding passageways into places which cannot be reached by conventional thermocouples.

Construction of the thermocouple consists mainly of inserting a thin insulated constantan (copper-nickel-manganese alloy) wire into a small-diameter inconel tube of the hypodermic needle type and drawing the tube through a die on a drawbench, thereby tightly gripping and sealing the wire within the tube. The inconel tube and the constantan wire, being dissimilar materials,

comprise the couple components. The fabrication of the thermocouple is completed by fusing the wire and tubing at one end.

Conventional thermocouples usually are enclosed in an impervious metal or a ceramic tube in order to protect the two wires from damage due to heat, chemicals, and friction. By using the wire and tube type of construction, the diameter of the couple was greatly reduced, and by utilizing an inconel tube, which does not corrode easily, the need for an over-all protective tube was eliminated.

Thermocouples which are 0.040 in. in diam and 20 ft in length have been constructed and used by Argonne scientists to detect and record temperatures up to 1250 F.

Atomic Battery

An atomic battery, developed at Tracerlab, Inc., Boston, Mass., uses radioactive tritium as the source of initial power.

Unlike other proposed nuclear batteries, it is claimed that there is practically no danger associated with the use of the tritium isotope used in this battery, because the beta rays it gives off are so weak they can be completely absorbed by a piece of newspaper.

The experimental batteries produced thus far can give up to 400 volts at very low current and have many commercial applications and military uses. The amount of tritium contained in the batteries ranges in cost from $1 to $100, at present prices, and will produce 0.01 to 1.0 microwatts of power.

The new batteries have an optimum useful life of 18 years, but can be made for a useful life of from 10 to 30 years depending on the design.

Construction and principle of the battery is quite simple. A cylinder smaller than a conventional flashlight battery is filled with the radioactive medium which surrounds pairs of metal plates having different surface electrical characteristics. These characteristics serve to attract the radioactivated current, thus producing useful external current. The radioactivated current reaching the plates delivers a voltage in proportion to the difference in the surface electrical characteristics of the plates.

The batteries can conceivably be used in hearing aids, survey instruments for measuring radiation following an atomic blast, electrical fuses or trigger-alarm devices, and in other sensitive instruments requiring a low-level power supply having long life.

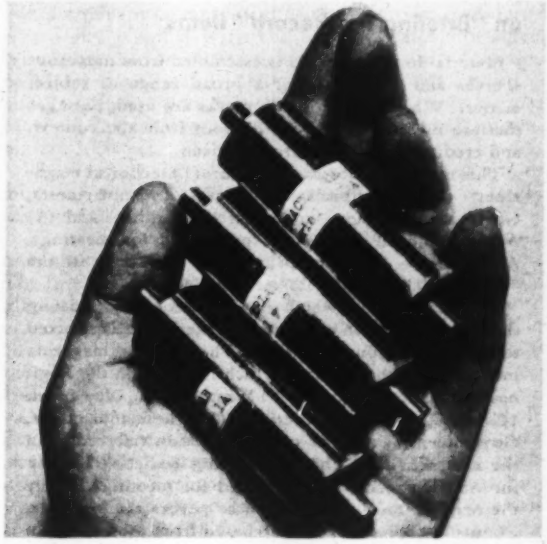


Fig. 14 Atomic batteries developed by Tracerlab, Inc., can provide up to 400 volts at 0.01 to 1.0 microwatts of power.

Atomic Thickness Gage

A fission product of uranium is being used in a new gage which continuously measures the thickness of metallic coatings on a rapidly moving steel strip.

Initial application of the atomic instrument is in Armco Steel Corporation's continuous zinc-coating process. The gage not only continuously measures the thickness of the zinc coating but does so along the length of the strip, across its width, and on both sides.

Result of a three-year joint research program by Armco and the Industrial Nucleonics Corporation of Columbus, Ohio, the nuclear gage makes possible improved quality control and increased efficiency in coating operations. It also creates the opportunity for automatic control of the coating process.

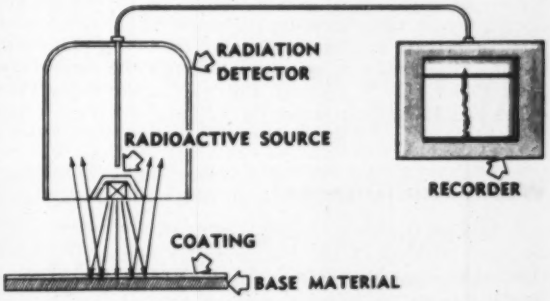


Fig. 15 How atomic gage measures the thickness of zinc coating on steel strip galvanized in Armco's continuous process.

Formerly, zinc-coating weight was determined by chemical analysis of samples taken from finished sheets or coils. Now the weight of coating is determined instantaneously only minutes after the steel strip leaves the zinc pot.

Heart of the new gage is a radioactive element which emits beta rays. A radiation detector picks up the rays which are reflected by the coated steel. These impulses are translated in an electronic unit into inked lines on a recording chart. They indicate the thickness of the coating in standard units.

The gaging head of the unit automatically ranges across the width of the strip and gives an almost instantaneous measurement of the coating weight on the entire length of steel strip. Armco is using two gages to measure the coating on both sides of the strip. With chemical analysis only an average coating weight for both sides is obtained.

Called the Accuray Reflection Gage, the atomic measuring instrument detects even minor variations in coating weight. And besides accuracy, the gage in-

cludes automatic compensation for changes in humidity, temperature, and dust content of the air.

Proportional Counter

Information concerning the design, construction, and operation of a shockproof boron trifluoride proportional counter for the detection of thermal neutrons was released recently by the Atomic Energy Commission. The counter, which was designed primarily for use in the nuclear-propulsion plant for the submarine *Nautilus*, has many potential industrial and research applications because of its sturdiness and ability to withstand high temperature.

The counter is one of three instruments especially developed to withstand the heavy stresses of submarine operating conditions and to resist the high temperatures of the nuclear power plant.

Developed by the Westinghouse Electric Corporation for the AEC, the counter is an example of the invention of special equipment required for AEC work and of potential value in nongovernment activities. The Commission is making available detailed information for the benefit of any firm or person interested in using such equipment or manufacturing it for the AEC, its contractors, or private industry. Details, including plans and specifications, may be obtained through the Pittsburgh Area Office, U. S. Atomic Energy Commission, Post Office Box 1105, Pittsburgh, Pa.

Waste-Acid Disposal

A PROCESS that may largely eliminate the waste-acid-disposal problem of the steel industry and at the same time save large quantities of acid was described to a meeting of the American Chemical Society recently, in Kansas City, Mo., by Arthur M. Fradkin and E. B. Tooper of the National Aluminate Corporation, Chicago, Ill. Their report was based on a laboratory investigation.

Every year the industry disposes of about 600,000,000 gal of waste acid from its "pickling" operation, in which rust and scale are removed from steel sheet, wire, pipe, and other products, the report stated.

The pickling process consists of immersing the steel products in sulphuric acid for a short period, according to the report. Iron compounds are formed by the action of the acid on the rust, and as the process proceeds the acid is thus used up and the iron compounds accumulate in the pickling tank. The liquid eventually loses its effectiveness and must be discarded.

Unless chemically neutralized, the dumping of large quantities of waste acid into a stream may destroy aquatic life and contaminate a water supply farther downstream, it was said.

The main part of the new process consists of an "ion-exchange" procedure in which the spent pickling liquid is passed through a tank containing a resinous material called Nalcite HCR. This "ion-exchange resin," which has been prewashed with acid, removes the dissolved iron and fully recovers the sulphuric acid for re-use in the pickling operation.

When the resinous material becomes saturated with the iron compounds, it can be washed with hydrochloric acid and re-used. The resulting iron chloride by-product is a common chemical that can be used in industrial and municipal water-treating plants. It also could be treated and sold as a paint pigment, or recharged into the steelmaking furnaces, it was indicated. The unused hydrochloric acid can be recovered and used again.

The new process provides an effective method for continuously controlling both acid and iron concentration of the pickling liquid and should result in more uniform and predictable pickling results, it was stated.

Although a 100 per cent recovery of materials cannot be claimed for any process, this ion-exchange method greatly reduces the amount of new acid required for pickling. Any plant adopting the method should eliminate to a large extent its acid-waste-disposal problem and effect a marked reduction in its sulphuric-acid consumption, the report concluded.

Air-Pollution Control

USE OF oil spray to further improve the control of airborne wastes at an industrial plant has been successfully achieved by co-operative action of the Disco Company, a division of Pittsburgh Consolidation Coal Company, and the Gulf Oil Corporation's laboratories, both of Pittsburgh, Pa.

Disco had spent approximately $250,000 to control its handling, heating, and crushing of coal and carbonized coal particles, in order to avoid objectionable quantities of dust and smoke. The results, while adequate, fell below the company objectives in cleanliness. Disco makes a coked pellet for heating purposes.

In the process, crushed fines recovered from screening of the finished product are mixed with crushed coal, heated in roasters and kilns for low-temperature carbonization, and then reduced to maximum 6-in-diam size by crushing.

How to Obtain Further Information on "Briefing the Record" Items

Material for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

This material is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources; i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

Mechanical measures to prevent dust emission are installed at a number of these points. In one of the most difficult phases—satisfactory control of dust in the preheating ovens where temperatures are brought up to 600 F—cyclonic dust collectors are used.

It was in the belief that oil sprays would contribute to the effectiveness of this equipment that Gulf laboratories were asked to make studies on the oil-spray requirements. This investigation established that oil could be used economically under conditions existing at the plant.

Next, a series of tests were run at the plant, using a special oil provided by the laboratories. The oil was disseminated through a Gulf-developed nozzle designed to produce an unusually fine spray.

Results proved decisive. Where the oil hit the mixing point of the fines and crushed coal only a white vapor was given off. When the sprayed raw material was fed to the roasters, the only resulting discharges from the stacks were thin white plumes.

The oil apparently functions by coating the powdered fines and coal so that all dust is held on the surface and carbonized with the product, the company reports. A certain amount of product is saved in this manner, reducing the cost of treatment.

In addition, a further reduction in exposure of bearings, conveyers, and belts to dust abrasion appears likely to assure considerably longer life to plant equipment and to generally reduce maintenance costs.

Large-Screen Color TV Tube

A NEW color television picture tube that produces a 20-in. (diagonal) color picture, comparable in contour and size to the standard 21-in. black-and-white tube, is under development by the Westinghouse Electronic Tube Division. The developmental tube, first shown publicly at the Institute of Radio Engineers Show in New York, N. Y., is a directly viewed tricolor tube employing a single gun and deflection-grid color pack.

A significant advancement in the new tube is its larger screen size coupled with the use of a phosphor screen which has 20 complete color groups per inch compared to 17 previously used. This gives improved resolution and excellent color definition at normal viewing distances. The total viewing area of the screen is approximately 200 sq in.

The over-all size of the tube has been held to a minimum by using a 24-in. (diagonal) rectangular metal cone and 70-deg deflection.

The screen of the tube consists of lines of three-color phosphors which produce the colors red, green, and blue. The lines, 80 per inch, are alternately deposited on a flat glass plate by either silk-screen printing or a photographic process. The complete color-pack assembly includes the beam-deflecting wire grid, mounted parallel to the phosphor lines, so that the grid is between the screen and the gun.

A 3.58-mc sine-wave signal applied to the grid deflects the beam alternately over the three-color phosphors. Color information is applied sequentially to the single gun in synchronism with the 3.58-mc switching signal so that at the instant the beam is focused over one of the phosphors, it is carrying the appropriate color information.

Westinghouse engineers emphasized that the new tube, believed to be the first 24-in. rectangular color tube to be developed, is still in the laboratory stage. The tube employs but one of several technical approaches that Westinghouse engineers are exploring as a part of the Electronic Tube Division's program to develop color cathode-ray tubes, with larger picture sizes at lower cost, which will be commercially attractive to the customer.

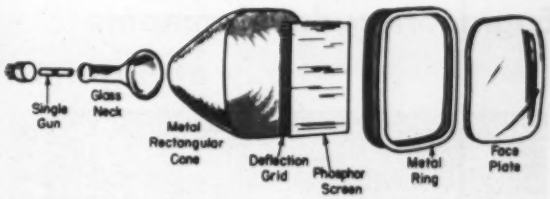


Fig. 16 Components of the deflection-grid color TV tube.

Iron-Ore Output and Imports

MORE iron ore was produced in the United States during 1953 than ever before, according to *Steel Facts*, April, 1954. A record was also set in imports of iron ore to this country, according to government reports. The domestic production was 133.5 million net tons, exceeding the previous record high total, in 1951, by about 3 million tons. The imports totaled 12.4 million tons, nearly one million tons more than the record set two years ago. In this country, the Lake Superior iron-ore ranges accounted for a little more than 80 per cent of total iron-ore production, or 107.6 million net tons. The southeastern states produced 6.4 per cent of the national total; the northeastern states had an output equaling 5.0 per cent; and the western states accounted for 7.5 per cent. Among individual states, the largest producers were Minnesota, Michigan, Alabama, Utah, and New York, in that order. Eighteen states reported iron-ore production in 1953, according to the Bureau of Mines.

Taconite, a low-grade, hard ore found in the Lake Superior region, came in for considerable attention and development during 1953. A major plant at Beaver Bay was under construction. When ready for operation it will produce 3.75 million tons of concentrate per year. A smaller taconite processing plant went into production at Iron Mountain last June, and another plant to be built at Aurora was financed, with construction to start this year.

Around $300,000,000 will be spent for one of the taconite development projects alone, it was estimated. Three years will be required to build the iron-ore treating plant, railroad, powerhouse, harbor, and two towns. Altogether, this project is reported to be the largest private construction undertaking now under way in the United States.

Another taconite plant with its associated facilities has been under construction for some time, at an estimated cost of around $160,000,000. At a third project, the pilot plant has been finished, and further plans are being studied.

The record of iron-ore imports, amounting to 12.4 million tons, was partly due to development work in foreign ore fields by American companies, during recent years. Shipments were received from a total of 19 countries, and in five of the top ten, American men and equipment are actively participating.

Engineering developments . . . at a glance

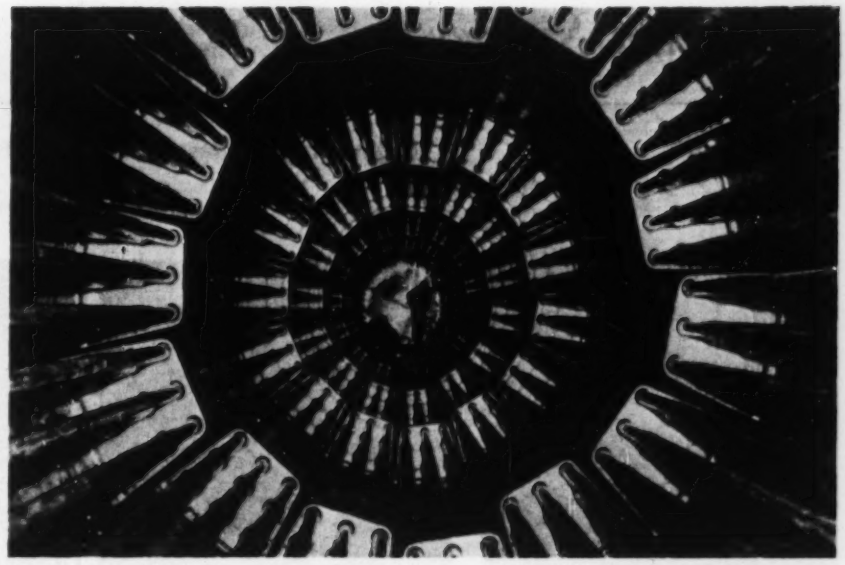
Bonded-Rubber Linings. By using bonded-rubber linings, failure of equipment and repair "shutdowns" due to the disintegration of metals is being greatly reduced, according to Goodyear Tire and Rubber Company, Akron, Ohio. Here a brine tank receives a rubber lining which will add years of effective operation to its life. The product is applicable to all shapes and sizes of tanks, castings, and welded equipment. Welded to metal, it can effectively seal against most corrosive liquids, it will not slough off, and it will not crack or buckle under alternate drying and wetting. The usual lining consists of a $^{3}/_{16}$-in. nonporous sheet. Units such as tumbling barrels which contain abrasives to smooth and polish rough edges of metal parts require linings as much as $^{1}/_{2}$ to 1 in. in thickness.

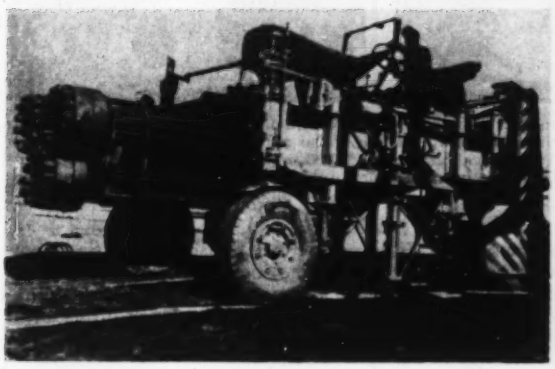
Compact Belt-Polishing Unit. A belt-polishing machine with contact wheel, idler wheel, and drive motor all mounted on a single base is now being made by Stephen Bader & Company, Rockville Center, N. Y. This single-based polisher not only occupies a minimum space, but simplifies installation, eliminates tracking problems, and reduces the need for adjustments during operation. The machine uses a standard 132-in. belt length with a variety of contact-wheel sizes. The unit can also be adjusted to permit the operator to stand while working.

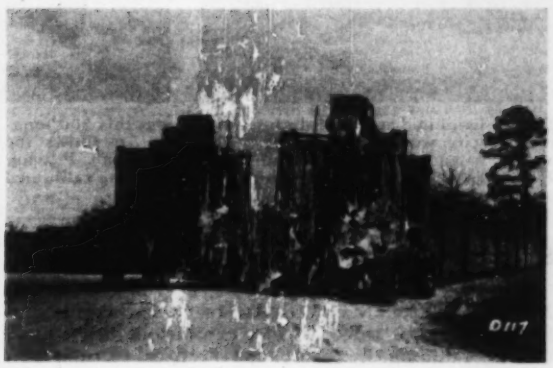
Protective Garments. Noncombustible Fiberglas insulation and coated or aluminized glass cloth are being used in the newest type of lightweight garments, manufactured by Fyrepel Products, Inc., Newark, Ohio, to protect industrial workers who must be exposed to high temperatures. This outfit, known as the Kool-Suit Model 900 AL, consists of a helmet, coat, trousers, and boots, all weighing only 26 lb. The Fiberglas insulating mat is faced on the "hot-side" with the glass cloth, and on the "cold-side" with denim, flannel, or other rugged fabrics fitting the intended end use of the garment. The helmet is adapted for an air-supply line or an air pack.

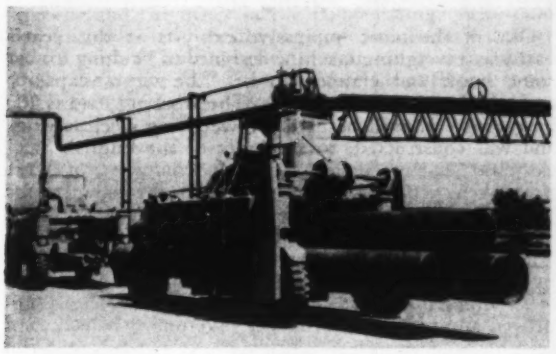
Turning and Grinding Machine. This new precision turning and grinding machine developed especially for the jet-engine industry, but applicable to any work on which exceptional tolerances are required on concentricity and parallelism of turned and ground surfaces, has been announced by the Frauenthal Division, Kaydon Engineering Corporation, Muskegon, Mich. Designed to perform multiple turning or grinding operations in one setup, the new 3100 Series machine includes four table sizes—36, 42, 48, and 52 in., all with a 60-in. swing. Power for driving the worktable is provided by a 10-hp d-c drive unit, with power transmitted through a "timing" belt.

Rotary Steam-Tube Drier. Interior view of a 100 × 10 ft Louisville Steam Tube Drier. Said to be one of the largest built to date, the unit will be used to dry fine solids which travel the length of the drier. Alcoa 61S plate lining, Alcoa 63S pipe, and cast-aluminum supports can be seen in foreground. In background, toward drier discharge end, 63S finned tube is used for final drying sections. Workmen are completing fabrication at a General American Transportation Corporation plant. Driers have 23,700 sq ft of heating surface in steam tubes. Together with other pressure parts, the tubes are of adequate strength for 200 psig pressure. Each drier contains approximately 35,000 lb of aluminum.









Over-the-Load Materials Handling. Long identified with the lumber industry, applications of straddle-carrier type of industrial trucks have now spread to metalworking, canning, construction, distilling, petroleum, manufacturing, and other industries, according to Clark Equipment Company, Battle Creek, Mich. *Upper left:* Straddle carrier transports heat exchanger at oil company in Houston, Texas. *Upper right:* Transporting high-stacked loads of hardwood to and from drying kilns with a straddle carrier of special design. *Lower left:* Over-the-road interplant transporting of long pipe by straddle carrier. *Lower right:* Pineapples are straddle-carrier-handled in bulk. The carrier straddles the flat-bed trailer to deposit or unload standard-container loads. Clark's Ross Carrier Division makes 10,000-lb to 45,000-lb-capacity carriers.

European Survey

Engineering Progress in the British Isles and Western Europe

J. Foster Petree,[1] Mem. ASME, *European Correspondent*

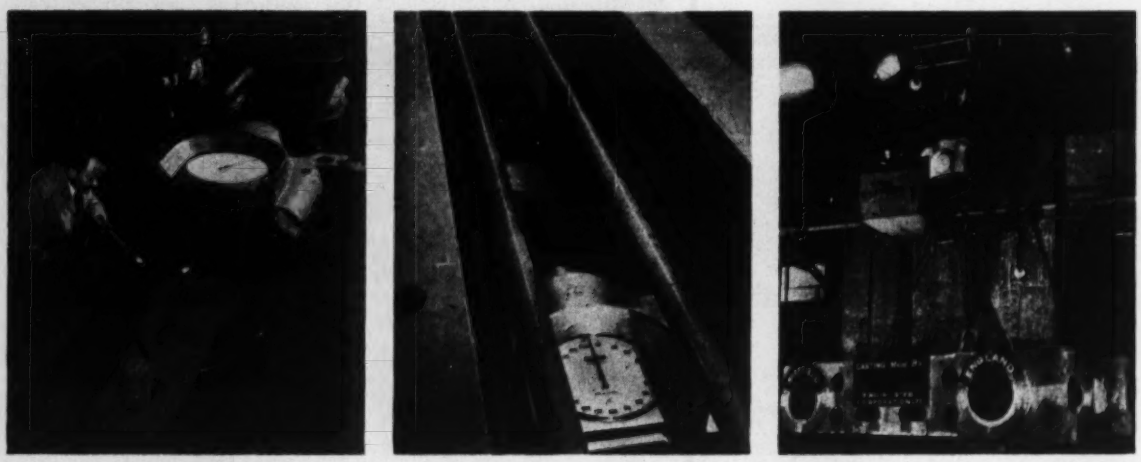


Fig. 1 Exhibited at British Industries Fair was this 200-long-ton-capacity weighing machine. Photo at *left* shows the spring balance during overload testing at Lloyd's Proving House; in *center* photo the machine is shown being calibrated in the University of Birmingham's 300-ton tensile tester; in the photograph at *right* the machine is shown weighing a 160-ton casting for a 35,000-ton hydraulic press, in the manufacturing works of the English Steel Corp., Sheffield, England.

British Industries Fair

THE 1954 British Industries Fair, held in London and Birmingham from May 3 to May 14, was arranged, as in former years, as three distinct exhibitions. The engineering, building, hardware, and electrical sections were displayed at Castle Bromwich, Birmingham, and were organized by the Birmingham Chamber of Commerce; all the other sections were shown in London, some at Olympia, and some at Earl's Court. Not all of the engineering items, however, are exhibited at Birmingham; it has been customary for printing and bookbinding machinery, office machinery, scientific and optical instruments, and certain other specialized technical sections to be displayed at Earl's Court. Moreover, those branches of the engineering industry which hold their own periodical exhibitions—for example, the makers of machine tools, of mechanical-handling equipment, automobiles and commercial motor vehicles, and many suppliers of marine machinery and associated plant—do not take any official part in the B.I.F. On the other hand, the trade associations which organize these separate exhibitions are not, as a rule, all-embracing in their several fields, so that there are usually some exhibits to represent most of these branches of engineering development; and many of the larger firms, while debarred by trade agreements from showing some of their manufactures, are still able to take part by exhibiting products which are not covered by those agreements. Thus, while the booths at Castle Bromwich and Earl's Court cannot be said to cover the whole engineering industry of Britain, they do present a reasonably typical picture of its extent and variety.

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.

World's Largest Spring Balance

ONE of the most impressive exhibits at this year's Fair was a weighing machine designed to be slung from a crane hook and claimed to be "the largest-capacity spring balance in the world." The working load is 200 long tons. It will be used for weighing steel castings and was constructed, to the order of the English Steel Corporation, by George Salter & Company, of West Bromwich, who have been making spring balances for 194 years. The balance itself weighs more than 6 tons and measures 12 ft in height from the bottom of the double ram's horn hook to the top of the two shackles by which it is suspended. Despite its size, however, it is a precision instrument and has been officially approved and passed as such by a government inspector of weights and measures. The dial is marked in 1-ton subdivisions. The spring assembly is technically interesting, as it consists of two Belleville washers—dished steel disks, 18 in. in diam and 2 in. thick, placed with their concave surfaces together. This type of spring washer was devised by the French engineer Belleville, who invented a succession of marine water-tube boilers in the latter half of the nineteenth century, by which he is chiefly known.

The central shaft or "middle piece" of the balance passes through holes in the centers of the two disks, being bushed in the upper disk but having a clearance through the lower one. The hook is attached to its lower end and on the upper end is a nut which bears on the upper disk. When the load is applied, the hook and middle piece are drawn downward, compressing the washers together against the top of the case. For the full load of 200 tons the amount of compression is only $^1/_8$ in. This small vertical movement is converted by a quadrant and pinion to the rotary movement of the pointer round the dial. An overload test of 300 tons was applied to the balance at the Netherton proving house of Lloyd's Register of Shipping, where ships' anchors and chain cables are tested; no permanent distortion or weakness was observed. The machine was then taken to the Civil Engineering Department of Birmingham University for calibration in the University's 300-ton tensile-testing machine. A full load of rather more than 200 tons was first applied, and the dial was then marked off, at increments of 10 tons, from the load readings on the steelyard of the testing machine. Twelve runs of 10-ton increments were made, checked, and rechecked, and the machine was then passed and stamped by the government inspector, in compliance with the law regulating the commercial use of weighing machines.

Gas-Turbine Fire Pump

The designers of the gas-turbine fire pump illustrated on page 275 in the March, 1954, issue of MECHANICAL ENGINEERING, were not alone in that field; Sigmund Pumps, Ltd., of Gateshead-on-Tyne, England, showed at the British Industries Fair a portable fire pump, driven by a Rover industrial-type gas turbine, which delivers 400 gpm (equal to 480 U. S. gpm) and weighs complete only 215 lb. It has a 4-in. suction branch and two $2^1/_2$-in. discharge branches and will deliver against a total head of 231 ft when drawing from 10 ft static lift through a suction strainer. The single-stage impeller rotates at 4500 rpm and is driven through double-reduction gearing, one stage of the reduction being in the turbine and the other in the pump casing. The pump is equipped with pressure gages on suction and delivery and a priming unit consisting of an air ejector supplied from the compressed-air receiver of the turbine; it will lift water 24 ft at not less than 1 ft per sec at atmospheric pressure.

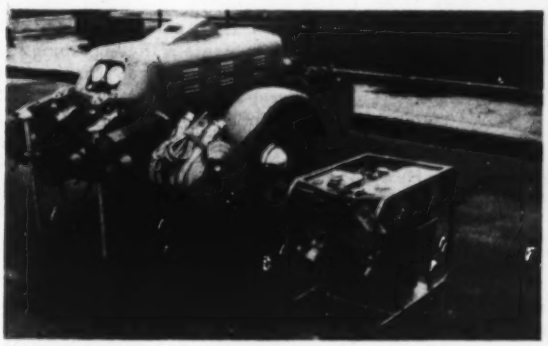


Fig. 2 Sigmund-Rover industrial-type portable gas-turbine fire pump, *right*, as compared with 500-gpm trailer pump.

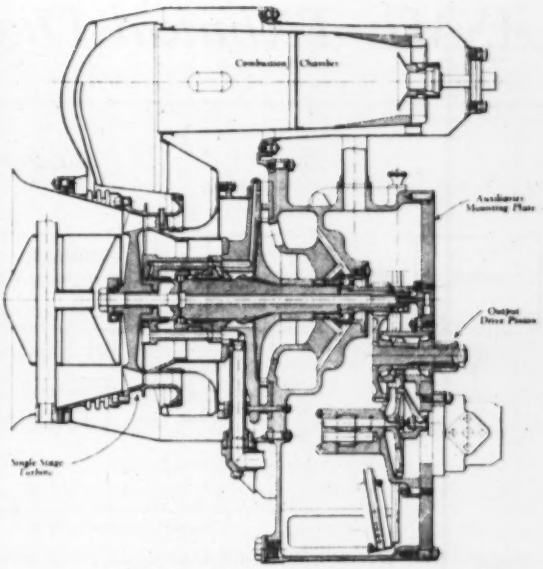
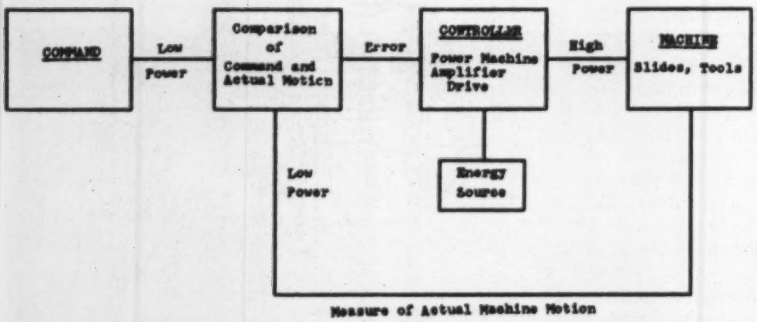


Fig. 3 Section through the 60-bhp industrial gas turbine.

The turbine has a continuous rating of 60 shp at a rotor speed of 46,000 rpm. The drive to the pump is taken from the shaft of the single-stage centrifugal compressor, which has a rotor of forged aluminum alloy and steel guide vanes. The axial-flow turbine rotor is a forging of Nimonic 90, the blades being integral with the disk. The fuel-supply system and the governor form a self-contained unit, driven through reduction gearing from the compressor shaft, and comprise a starting control, accelerator control, maximum-speed and maximum-temperature controls, and a fuel filter. A gear-type lubricating-oil pump is submerged in the sump in the base of the compressor housing and has a filter on the suction and another on the delivery. Connections are provided for cooling the oil in the sump. The Lucas combustion chamber can be fitted with either a spill-type burner or with the pressure-sensitive variable-flow type. The fuel consumption at the stated continuous rating is 1.4 lb per bhp per hr. The mass air flow is 1.35 lb per sec, and the jet-pipe temperature is 600 C. The fuel may be commercial gasoline or kerosene, diesel fuel, or any distillate fuel, and the tank has sufficient capacity for 25 minutes' operation. The pump and turbine are mounted together in a steel-tube frame, fitted with carrying handles which fold down when not in use; the outside dimensions are 2 ft $8^1/_2$ in. long, 1 ft $7^1/_2$ in. wide, and 2 ft 1 in. high. The starting handle, which also folds down within the frame, is connected through sprockets and a chain to the oil-pump driving gear and so rotates the compressor shaft through the intermediate gear of the train that drives the auxiliaries; the over-all ratio between the compressor and the handle is 100:1. The chain drive includes a free wheel, completely enclosed and automatically lubricated. The starting mechanism also operates an electric generator to provide the spark to ignite the mixture in the combustion chamber. The accompanying sectional illustration of the Rover turbine, which is now in commercial production, is taken from *Engineering* (London) of April 16, 1954.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings



Basic control system with feedback as applied to automatic machine control.

Machine Design

Automatic Control—Principles of Feedback and Their Application in Machine Control, by Perry L. Nies, Ultrasonic Corp., Cambridge, Mass. 1953 ASME Annual Meeting paper No. 53—A-140 (mimeographed; available to Oct. 1, 1954).

THE paper discusses at a concept level the basic need for application of feedback principles in machine control and attempts to describe the interrelation of static and dynamic accuracy, stability, damping, response time, phase shift, and other feedback characteristics. The paper is a basic approach to principles of feedback control, described and interpreted without the assistance of mathematical derivation.

A machine and control apparatus exist in a changing environment, but must accomplish useful work both accurately and economically in spite of external disturbances. The principles of feedback are applied to machine control to overcome the undesirable effects of vibrations, nonlinear loading, changes in temperature and humidity, and deterioration of the machine itself.

A feedback-control system is used to force a machine to follow a varying command signal or to hold the machine within close limits to a fixed command level. The advantages of the feedback-control system over the open or nonfeedback system lie in the ability of the former to force a machine to follow, at a predictable rate and predictable accuracy, a varying input command and to correct for the effect of changes in environment and the control components themselves without human attention. To secure these advantages, the feedback-control system must be designed properly, the power supply must be adequate, and the machine must be sufficiently rugged or delicate for the work accomplished.

In designing a feedback-control system, the designer must first frame his problem by specifying the performance of the output machine in terms of speed, acceleration, torque, accuracy, and allowable overshoot. He must consider the alternately available types of input-command devices, in relation to the input command, be it manual, semiautomatic, or automatic. He must establish the probable type, frequency, and magnitude of external disturbances under which the feedback control must operate. The designer is then free to incorporate these factors into design of the control loop itself.

In designing a feedback-control loop, the objective is to provide accurate regulation of the machine position and motion and rapid recovery following any disturbance, with a minimum of oscillation about the desired output level.

Design of Hydraulic Equipment for Heat Dissipation, by J. R. Hemeon, General Motors Corporation, Trenton, N. J. 1953 ASME Annual Meeting paper No. 53—A-177 (mimeographed; available to Oct. 1, 1954).

HYDRAULIC equipment is a heat generator. The assembly of pumps, valves, and piping, without due consideration to the anticipated pressure-time cycle of operation, the Btu per hr generated, and the balancing capacity for heat dissipation—will develop an excessive sump-oil temperature, which reduces the useful life of the hydraulic oil. The Ternstedt Trenton Plant of General Motors Corporation designs, constructs, and operates several types of high-speed, automatic, hydraulic-powered machines.

Design-analysis data are presented covering the heat factors which must be considered. Tank capacity and design are important. The rates of cooling from air flow over thin-wall steel tubing, fin coolers, chamber capacity, and water coolers are evaluated. The end result is to provide that economic heat-dissipation system which will insure a satisfactory sump-oil temperature. The dividend is increased oil and pump life, with extended periods between preventive-maintenance overhauls.

The paper takes up generation, radiation, fan cooling, and water cooling.

According to the paper the first problem is an understanding of a measurement of the heat generated. The best method to evaluate this factor is to compute the pump output in terms of Btu per hour.

Radiation in this paper is construed to encompass the provision for the tank to transfer heat from the return oil through the thin tank walls to the cool floor-level air. This radiation is further augmented by the transfer of hot chamber air through the chamber cover and walls.

Fan cooling in this paper presents the use of a TEFC pump motor and the arrangement of thin-wall steel tubing and fin coolers, so located in the influent and effluent-air stream to dissipate heat from the hot-oil flow in tubing most economically. Water cooling is used on high-duty cycles of operation where there is insufficient radiation and fan-cooling capacity to balance the generated heat.

Preventive maintenance started in 1947 in the die cast department at Trenton and is now plantwide. The performance of hydraulic equipment has been outstanding. Uncontrolled temperature can be disastrous in causing machine

failure and frequent repair calls. The compilation of service-failure data, improvement of low life-expectancy units, and the design of hydraulic equipment for heat dissipation for a sump-oil temperature of 115 F have been large contributing factors in extending the satisfactory hours of operation between scheduled overhauls.

The Borg-Warner Ford-Mercury Automatic Transmission Controls, by R. W. Wayman, Assoc. Mem. ASME, Borg-Warner Corp., Muncie, Ind. 1953 ASME Annual Meeting paper No. 53—A-145 (mimeographed; available to Oct. 1, 1954).

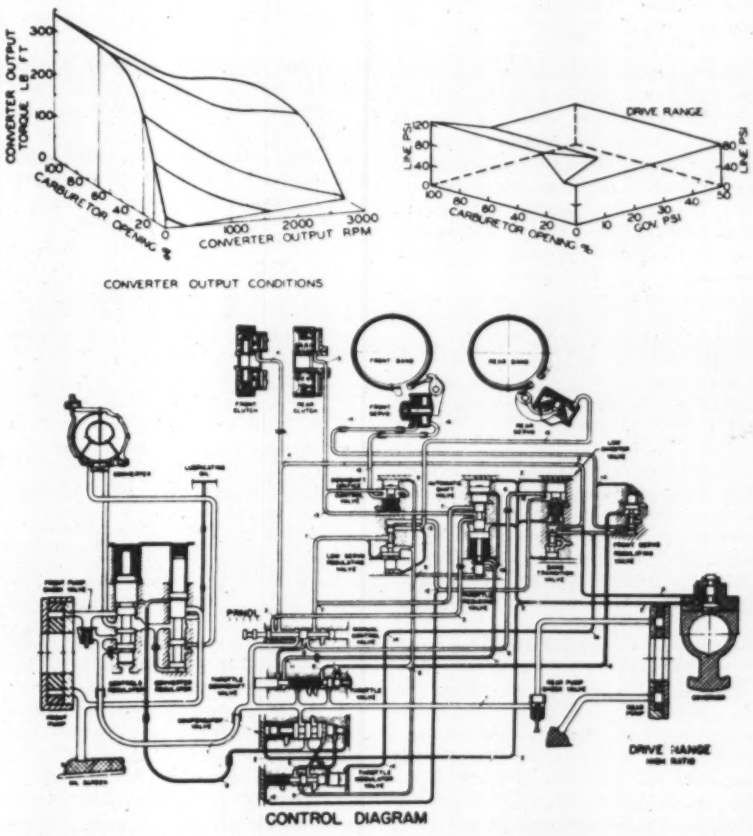
For a given transmission design, the formulation of an automatic transmission control system is presented. Due to limitations of space and cost an all-hydraulic control is used. Through a driver-operated selector level connected to a valve in the transmission and by means of a carburetor linkage-actuated regulator termed the throttle valve the transmission "feels" the driver's commands.

Another regulator actuated by centrifugal force due to its being mounted on the output shaft is termed the governor and provides speed "feel." These pressures act on opposite ends of the shift valve to provide automatic shifts at proper speeds.

Full use is made of these pressures to regulate the various transmission control pressures to provide a characteristic as shown in the accompanying figure under line psi. This covers the wide converter output torque variation illustrated. All the control components are shown in the control diagram.

Operation of the complete system can be determined quickly by the use of one pressure gage and a short driving procedure.

Servicing is almost entirely from the underside by removing the oil pan, thus providing easy accessibility. Oil used is the readily available Type A Fluid.



Automatic transmission control diagram shows friction elements, pumps, and converter. ***Top left:*** **Converter output conditions.** ***Top right:*** **Line pressure buildup.**

Contributions to Hydraulic Control, VI' New Valve Configurations for High-Performance Hydraulic and Pneumatic Systems, by Shih-Ying Lee, Massachusetts Institute of Technology, Cambridge, Mass. 1953 ASME Annual Meeting paper No. 53—A-139 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

In high-performance hydraulic and pneumatic systems three-way or four-way valves of very high precision are required. Conventional spool-type valves used for this purpose have been found to be difficult and expensive to manufacture. This paper describes a new type of metering orifice and several valve designs utilizing this metering orifice. These valves have proved to be considerably easier to make and more trouble-free than the piston-type design with the same performance. Flow-force-reduction methods for this type also are described. The work reported in this paper was carried out at the dynamic analysis and control laboratory and was supported by the U. S. Navy Bureau of Ordnance Contract NOrd 9661 with the Division of Industrial Cooperation of the Massachusetts Institute of Technology.

Mechanical Analog-Computing Elements and Their Applications to Automatic Control, by Alvin Piatt, Assoc. Mem. ASME, Librascope, Inc., Glendale, Calif. 1953 ASME Annual Meeting paper No. 53—A-141 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

In this paper some representative mechanical computing elements are described. The manner in which these computing elements can be utilized in computing systems applicable to the automatic control of industrial processes also is discussed. As examples of the way in which these mechanical computing elements can be used in computers, a computing flowmeter and a multi-element controller for a heat-transfer process are described.

Metal Processing

On the Theory of Regenerative Chatter in Precision-Grinding Operations, by Robert S. Hahn, Mem. ASME, The Heald Machine Company, Worcester, Mass. 1953 ASME Annual Meeting paper No. 53—A-159 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

In precision-grinding operations a build-up of vibration during the grinding process frequently occurs. When precision parts are being ground, such as ball-bearing raceways and the like, any

vibration of the grinding wheel relative to the workpiece is detrimental and interferes with the precision requirements of the part. Furthermore, these vibrations reduce the maximum permissible grinding rate and accordingly the rate of production.

In this paper the phenomenon of regenerative chatter is discussed. An analysis is made, based on the proportionality of the instantaneous wheel depth of cut to the instantaneous dynamic force existing between wheel and work, which yields two stability criteria from the Nyquist diagram. The grinding system will be unconditionally stable if one stability criterion is satisfied. If this criterion is not satisfied a second criterion may yet be satisfied by proper adjustment of the cycles of vibration per revolution of the workpiece. A qualitative check on the theory is given.

Machinability Research With J&L Tool Dynamometer on Titanium 150A, by Leib Fersing, Mem. ASME, and D. N. Smith, Jones & Lamson Machine Company, Springfield, Vt. 1953 ASME Annual Meeting paper No. **53—A-207** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

A BROAD definition of machinability would be the relative cost per sq in. of machined surface when all cutting conditions are at an optimum for most economical production. For several years the J&L tool dynamometer has been used successfully for evaluating a number of factors affecting machinability such as grades of carbides, types of coolants, methods of applying coolants, tool geometry, tool finish, cutting speeds, feeds, and materials. With knowledge of these factors, it is possible to approximate a most economical rate of production. In this paper the relation between changes in loads on tools and tool wear is shown through test results and how, in a short time, with the help of a tool dynamometer, reliable information for successfully machining titanium 150A was obtained.

Evaluation of Bandsaw Performance, by L. V. Colwell, Mem. ASME, and R. E. McKee, University of Michigan, Ann Arbor, Mich. 1953 ASME Annual Meeting paper No. **53—A-165** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THIS paper presents methods of evaluating bandsaw performance and discusses typical performance characteristics. Tests indicate that bandsawing has orderly and predictable machinability characteristics similar to other machining operations. Cutting speed and feed rate or feeding force are the more important variables requiring careful selection and control.

Some of the conclusions reached are as follows:

1 Bandsawing done with positive power feed is orderly and predictable.

2 The relative machinability of the five materials studied is about the same for bandsawing as it is for turning.

3 Titanium alloys can be sawed more satisfactorily by using positive motion power feed.

4 The end of useful tool life in bandsawing is accompanied by an abrupt increase in the feeding force required to sustain the same rate of metal removal.

5 Both cutting and feeding forces vary substantially linearly with the feed rate except for residual values at zero rate of metal removal.

6 The feeding force for sawing SAE 1045 steel is approximately half that required in the cutting direction.

7 The feeding force for commercially pure titanium is the same as that for cutting.

8 The feeding force for titanium alloys is substantially greater than that required in the cutting direction.

9 The coefficient of sliding friction between titanium and the bandsaw material appears to be significantly less than for SAE 1045 hot-rolled steel.

10 The exponential equation appears to be a more realistic form for expressing cutting force data for metal cutting in general.

Analysis of the Stresses in a Cutting Edge, by F. R. Archibald, Mem. ASME, Melrose, Mass. 1953 ASME Annual Meeting paper No. **53—A-160** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

IT IS apparent from even a superficial consideration of the chip forces on a cutting tool that the stresses in the region of chip engagement are high. This paper attempts a quantitative evaluation of these cutting-edge stresses. Certain assumptions on the chip-force distribution are made and the stresses are calculated by the techniques of two-dimensional theory of elasticity.

The paper deals with the stresses in the tool itself, these being within the elastic region. The conventional elasticity theory is applied to the tools and equations for the stress at any point in the vicinity of the tool tip are derived. Particular attention is given the point of the tool where the principal stresses are found to be a maximum. The values of stress at the tool tip are found to be considerably higher than would be allowed by the elastic limit of ordinary structures made from the same material. In this case the regions that are stressed are small as in ball bearings (where Herty stresses as high as 600,000 psi are obtained) and for this reason unusually high values of elastic limit obtain. The stresses that are computed here should be of interest in connection with tool-wear studies.

On the Drilling of Metals, Part I, Basic Mechanics of the Process, by Carl J. Oxford, Jr., National Twist Drill & Tool Co., Rochester, Mich. 1953 ASME Annual Meeting paper No. **53—A-167** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE cutting action of a twist drill is complex. This paper describes an investigation of this complex phenomena through use of a quick-stop technique to freeze the action. The formation of chips, both along the cutting edges and under the chisel edge, are considered. Chip-flow angles, measured experimentally, are related to effective rake angle along the cutting edges, using a new derivation of the normal rake angle for a twist drill. The effects of point angle, drill design, and workpiece material are considered. The split (crankshaft) point for heavy web drills is investigated and its operation described.

The Shear Stress in Metal Cutting, by Milton C. Shaw, Mem. ASME, and Iain Finnie, Massachusetts Institute of Technology, Cambridge, Mass. 1953 ASME Annual Meeting paper No. **53—A-158** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

WHEN metal-cutting stress-strain data are compared with data from other materials tests, poor agreement is observed. The several factors that could influence the flow stress in cutting are considered and it is found that the presence of a normal stress on the shear plane, the temperature on the shear plane, and the higher rates of strain in cutting are of negligible importance. The interrelationship between temperature and strain rate is treated theoretically and the two effects are found to tend to cancel.

It is shown experimentally that a material cut does not behave as an ideal plastic, but that the modulus of strain hardening is essentially the same at the high rates of strain encountered in cutting as in other materials tests carried out at low rates of strain. The principal discrepancy between cutting and torsion-

test data is seen to be due to the smallness of specimen size in cutting. The size effect that is observed in materials tests (tension and torsion) is shown to be in good quantitative agreement with the size effect observed when metals are cut at different feed rates. The presence of flow ahead of the conventional shear plane near the free surface is demonstrated and the importance of this preflow discussed. Part of the discrepancy between cutting and torsion test data is found to be due to use of chip length measurements in obtaining the shear area rather than measuring this value directly from photomicrographs. This flow ahead of the shear plane is also found to account for part of the discrepancy between computed and measured values of the shear angle.

An Experimental Study of Metal Extrusions at Various Strain Rates, by J. Frisch, Assoc. Mem. ASME, and E. G. Thomsen, University of California, Berkeley, Calif. 1953 ASME Annual Meeting paper No. 53—A-154 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

FROM a technological as well as a scientific point of view it is of interest to know the details of plastic motion within a metal during a metal-forming operation and the resulting stress and strain distribution. In this study a 4.3-in-diam cylindrical commercially pure lead billet was extruded at room temperature into a 1.5-in-diam solid bar at three extrusion rates of 0.1, 0.74, and 5.15 in. per min. Particle velocities, magnitude, and direction, for the inverted-extrusion process using a sharp-edged die, were determined on a meridian plane by a stepwise extrusion method.

The following conclusions were reached.

1 The flow patterns on the meridian plane of a lead billet extruded into a 1.5-in-diam solid bar with an 8.2/1 reduction ratio at room temperature were identical for rates of 0.1, 0.74, and 5.15 ipm.

2 The invariability of the flow pattern with extrusion rate agrees with theoretical predictions.

3 The wall pressure, as measured by a pressure gage, increased almost linearly with the extrusion rate. The applied load increased in a similar manner, such that the ratio of average extrusion load per unit area to the wall pressure remained constant.

4 The mean pressure within the metal cannot be recorded by a simple wall pressure gage whose response depends on elastic deformation of a pressure-sensitive element.

5 It was shown that the difference in the mean pressure in the metal and the pressure recorded by the gage differ by the magnitude of a critical flow stress.

6 The mean pressure calculated from a stress analysis using the experimental flow pattern agrees approximately with the measured mean pressure.

Cutter Life for Face-Milling Cast Iron, by W. W. Gilbert, Mem. ASME, and O. W. Boston, Fellow ASME, University of Michigan, Ann Arbor, Mich., and H. J. Siekmann, General Electric Company, Detroit, Mich. 1953 ASME Annual Meeting paper No. 53—A-149 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

A PAPER, "Power Required by Carbide-Tipped Face-Milling Cutters," by W. W. Gilbert, O. W. Boston, and H. J. Siekmann, was published in August, 1953, in Trans. ASME. This is a second paper to give the results of a series of tests to face-mill a variety of metals with cutters of various materials. The work was sponsored by the War Production Board under the auspices of the Office of Production Research and Development, through the Manufacturing Engineering Committee of The American Society of Mechanical Engineers. A great deal of data was obtained which, as yet, has not been published.

An extensive series of tool-life and power tests was made under controlled laboratory conditions, to evaluate the capacity of sintered-carbide, cast nonferrous metal, and high-speed steel face-milling cutters when milling several classes of cast iron. The variables reported here consist of the following: Grade of cast iron, tool material, feed, depth, width of bar, number of teeth in cutter, and the cutting speed. The effect of each variable was evaluated by making tool-life tests at several speeds to obtain cutting-speed tool-life curves ($VT^n = C$). All of these variables are finally summarized in a nomograph which shows the importance of each variable and predicts the tool life.

Power Test Codes

Some Statistical Methods for Evaluation of Experimental Results, by Eugene W. Pike, Raytheon Manufacturing Company, Newton, Mass. 1953 ASME Annual Meeting paper No. 53—A-164 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

STATISTICAL examination of mass-production methods results in improvement, better quality control, and more uniformity of billions of dollars' worth of industrial products produced each year by repetitive processes. This paper describes the logic and methods used in statistical quality control.

On the basis of his calculations the statistician can determine which measurements will respond most sensitively to the differences between equipment which meets specifications and equipment which does not. He can plan the experiment so that only those observations which contribute directly to the desired conclusions are taken. Quantities which are insensitive to the differences between acceptable and rejectable equipment need not be measured. Furthermore, the number of observations necessary to reach some specified conclusion with any desired degree of confidence can usually be estimated. Thus the cost of testing can be balanced against the cost of an incorrect conclusion; the degree of testing which leads to minimum total cost would be chosen, other things being equal.

In making these estimates, the statistician would make use of all the available information on the possible aberrations of the instruments and the personnel involved in the test. He would also make use of the best available engineering judgment as to the specific ways in which the equipment might be expected to deviate from specifications. The number of observations needed to decide with a given confidence between two specific alternatives is usually very much less than that needed to decide that some statement is true, excluding all possible alternatives.

A second, and probably even more important, contribution of the statistician to the process of testing is inherent in the fact that testing is a process. An acceptance test is a series of actions which are specified in advance, and then executed in reality. These actions are usually repetitive.

Mass production is exactly such a series of repetitive operations, specified in advance and then executed in reality. Because of their economic importance, mass-production processes have been studied in great detail by almost every kind of expert there is, including statisticians. As a result, a great deal is known about the characteristics of repetitive operations. The experimental fact which is of importance is that no repetitive operation is ever really repeated exactly. There are always changes with time, sometimes irregular, but usually systematic.

These unsuspected changes can be detected by statistical examination of the output of the process. Furthermore, this statistical examination of the output

often gives very helpful clues as to the form of the variation, and through this to the causes of variation. These causes can be identified and eliminated, one by one, with the result that the product of the process is much more uniform than it was originally.

Measurement Errors—Classification and Interpretation, by J. C. Boonshaft, Fischer & Porter Co., Hatboro, Pa. 1953 ASME Annual Meeting paper No. 53—A-219 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE classification and appearance of errors contributing to the uncertainty of measurement with industrial indicating and recording instruments are described, together with design details and measurement situations which affect them. Relationships and typical figures are given to show technique of evaluation of the precision, or internal consistency, of these instruments.

In this paper the subject is limited to recognizing the factors of which a numerical value of precision is composed in industrial-measuring instruments of the indicating and recording type. Principal consideration is given to the mechanical-pneumatic transmission and receiver devices.

The measurement from which a numerical value of precision for such instruments is determined must include a sufficient number to recognize the appearance of errors because of the following: (1) Scale factors, (2) direction of approach of variable to final reading, (3) just-past history of the measurement system, (4) length of time at reading, (5) life history of the measurement system, and (6) ambient factors, particularly temperature.

Design of Power-Plant Tests to Insure Reliability of Results, by William A. Wilson, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1953 ASME Annual Meeting paper No. 53—A-156 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THIS paper deals with the application of uncertainty analysis to the planning of tests. A technique for defining alternative features of test design and of choosing between them is discussed. It is shown that one automatically makes most of the important decisions with respect to test setup and procedure in the course of the uncertainty analysis.

The essential feature of the method is a series of uncertainty analyses based on procedures described by Kline and McClintock. These analyses are to be made in advance of the tests. They are applied to alternative test designs and provide a means of rating the suitabilities of the hypothesized procedures on the basis of the uncertainties which would derive from their application. Both the technique for selecting the alternatives to be analyzed and the methods of the uncertainty analyses themselves are considered. Final selection of test design is not discussed, but it is clear that the advantages of various values and distributions of uncertainty over the range of the tests must be weighed against the concomitant testing expense associated with possible test designs.

A general formula for establishing the essential features of a test is as follows:

1 Define performance parameters in mechanical and thermodynamic terms and classify them according to their independent or dependent character.

2 Work backward from these semiabstract parameters to observable physical quantities.

3 Consider alternatives.

4 Make preliminary uncertainty estimates.

5 Make detailed analysis of semifinal design.

6 Complete the test design by balancing uncertainties.

7 Take a final look at the complete test procedure.

Process Industries

A Direct Method for Flame-Temperature Calculation—Partial Oxidation of Methane, by F. D. Cardwell, Mem. ASME, Chemical Construction Corp., New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-203 (mimeographed; available to Oct. 1, 1954).

THIS paper illustrates the development of a simple formula for the direct calculation of the theoretical flame temperature that results when methane is burned with a deficiency of air producing a flue gas which is rich in carbon monoxide and hydrogen. This gas is known as a reducing gas or atmosphere and has many uses including those of a reformed gas. Preheated oxygen and steam may be added to the burner gases which also may be preheated to some desired temperature before combustion takes place. Provision is made in the formulation to include any combination of the foregoing which is known as the burner gas analysis.

The fundamental principles used in the development of the equations presented in this paper are as follows: First, since the effluent flue gas produced by the partial combustion of methane is combustible due to the presence of carbon monoxide and hydrogen, the reduced heat of combustion of the reaction is taken as the difference between the heat of combustion of the methane and the heat of combustion of the appropriate amounts of carbon monoxide and hydrogen in the effluent. The higher-heating values of the foregoing gases are used throughout, those of the latter two being approximately equal. Second, the total mols of CO plus H_2 depend solely upon the mols of oxygen in the burner gases, which is known. This means that the total mols of CO plus H_2, per mole of methane, is independent of the amount of steam used. This total is called the Hydrogen Potential since each mol of CO can be reacted with steam to produce one mol of hydrogen and CO_2. Therefore the reduced heat of combustion can be determined at once.

Use of Sorbents for Drying Process Gas and Air, by F. M. Waterhouse, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del. 1953 ASME Annual Meeting paper No. 53—A-204 (mimeographed; available to Oct. 1, 1954).

THE adjustment of ingredients of process gases, including air, often involves problems in water-vapor control. This moisture is present in clear vapor form, in mechanical mixture with the process gas or air.

Methods of drying gas or air have developed along two broad lines. One is dehumidification by cooling, which has been well explored and widely applied. The second is dehumidification by sorption, which involves the extraction of moisture by natural differentials in vapor pressure existing between a sorbent and its environment. Sorbents may be solids or liquids and depend upon physical or chemical actions or upon a combination of these means.

This paper reviews the theory of sorbent-controlled temperature and humidity, listing several available sorbents and indicating the criteria for selecting a control system involving sorbents.

Sorption appears to have been accepted for approximately thorough dehydration of gas or air to low moisture content, and now appears to have been developed to an extent that warrants economic consideration in an increasing number of cases involving moisture-content control at a specific level. A variety of well-developed "package" sorbers are available to adjust moisture and temperature to dew points ranging downward to —20 F. Control of lower dew points requires special engineering for large volumes.

Some conclusions reached by the paper are:

1 Sorbents, in combination with necessary heat-transfer equipment, offer an effective method for humidity control.

2 A wide range of dew-point temperature control is available depending upon the sorbent selected and the extent of contact with the sorbent.

3 The sorber is essentially a moisture-extraction machine and finds best application where the latent-heat load is large as compared to the sensible-heat load. The latent heat is converted to sensible heat at a higher temperature level, thus permitting the use of higher temperature coolant which may be an advantage.

4 Each application must be studied to determine whether the humidity and temperature controls can be effected best by sorbers, mechanical refrigeration, or a combination of the two. The cost and availability of water and heating steam as compared to electricity in a given process will largely determine the extent to which the sorber is economically justified.

Separation of Immiscible Liquids by Means of Porous Membranes, by George V. Jordan, Jr., Selas Corporation of America, Philadelphia, Pa. 1953 ASME Annual Meeting paper No. **53—A-221** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE principal mechanical methods presently employed by the process industries to effect a phase separation of immiscible liquids without alteration of mutual solubilities include gravitational, inertial, and centrifugal systems. All of these methods depend primarily on the differences in the specific gravities of the liquids to be processed and require considerable energy, time, or space for successful operation. These methods are in contrast to distillation, adsorption, and absorption which affect the mutual solubilities of the liquid and in addition, require the use of heat, specific adsorptives, or deliquescent materials.

Recent evaluations of certain basic principles of capillary physics and surface chemistry, in the light of their possible use as a fluid separatory tool, have brought about an additional mechanical method of separating immiscible liquids without altering mutual solubilities which utilizes, primarily, the interfacial tension value between the liquids and requires a minimum amount of energy, time, and space to effect a complete phase separation.

In the process industry, porous media are generally associated with filtration and diffusion. However, porous membranes also can be utilized for the separation of immisicible fluids—liquids from gases—gases from liquids—liquids from liquids. In this paper the phenomenon of interfacial tension separation as applied to liquid-liquid separatory systems is explained, together with a description of the porous membranes employed. Basic design data and operational features of liquid separatory units and systems are presented. Interesting applications and installations in the process industries are included.

Rubber and Plastics

Dynamic Characteristics of Silicone Rubber, by G. W. Painter, Lord Manufacturing Co., Erie, Pa. 1953 ASME Annual Meeting paper No. **53—A-88** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE unusual high and low-temperature properties of silicone rubber have made it a desirable material for vibration isolators designed for service at temperature extremes. In general, silicone cannot be substituted directly for such elastomers as natural rubber and neoprene in established designs. This lack of interchangeability results principally from the lower tensile strength and the unusual load-deflection characteristics of the material.

A program to investigate the dynamic properties of silicone rubber was undertaken to provide the design engineer with information which would allow the material to be utilized properly. This paper deals with the viscoelastic properties of silicone rubber under various conditions of strain, frequency, and temperature. Where possible, comparisons were made with natural rubber.

Viscoelasticity of Polymethyl Methacrylate—An Experimental and Analytical Study, by J. K. Knowles and A. G. H. Dietz, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1953 ASME Annual Meeting paper No. **53—A-100** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE time-dependent characteristics of the mechanical properties of high-polymeric materials are of considerable interest, both as an aspect of solid-state physics and for their importance in design considerations and other applications. Viscoelastic behavior, variously manifested as creep, stress relaxation, or strain-rate effect in the static range and as energy dissipation under dynamic conditions, has received much attention from the experimental, theoretical, and analytical viewpoints. Many materials have been studied under a wide variety of conditions and several efforts to describe and correlate mathematically experimental results have been reported in the literature.

This paper is concerned with a presentation of static tensile stress-strain data under many different experimental conditions on several types of methyl methacrylate, together with an empirical equation to describe them, and with an attempt to correlate the static behavioral characteristics of two varieties of methacrylate by means of an extension of the Boltzmann-Volterra theory of the elastic after-effect to an extent that facilitates the prediction of creep and constant strain-rate curves from stress-relaxation data to within an error acceptable for engineering purposes.

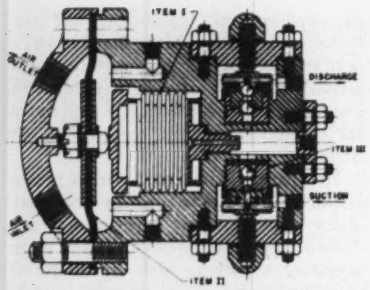
Petroleum Technology

The Automatic Sampling of Hydrocarbons in Direct Proportion to the Flow, by W. E. Gibson, Mem. ASME, Shell Chemical Corporation, Torrance, Calif. 1953 ASME Annual Meeting paper No. **53—A-148** (mimeographed; available to Oct. 1, 1954).

THE need of an improved means for obtaining composite hydrocarbon samples automatically has been recognized in the chemical and petroleum industry for years.

In order to eliminate the human element in this operation and assure reliable samples, an automatic composite sampler was designed. Specifications were as follows: (1) Fully automatic and leakproof; (2) frequency of the sample cycle in direct proportion to the line flow; (3) quantity of each sampling cycle sufficient to give a 4000 cu cm composite sample in 7 days; (4) adjustable for longer or shorter sample increments, if desired; (5) all drive equipment to be fully explosionproof.

The original design of the sample-pump element consisted of the three main component parts: The bellows measuring chamber and pump, Item I; the operating diaphragm, Item II; and the double-ball check valves, Item III. The space between the diaphragm and bellows is filled with a light grade of oil and connects to an atmospheric sight glass. This provides a means of detecting any leaks in the sampler. The quantity of the sample may be varied by changing the bellows size. The range, however, is limited to the economical design limitations of the bellows and requires dismantling of the unit with the attendant interruption in the sampling



Original design of the first automatic hydrocarbon sample-pump element.

cycle. This type of sampler operated successfully for 2 years.

In order to overcome the disadvantages in this model and provide greater flexibility, a new element was designed. In this unit the bellows and diaphragm were replaced by a floating piston, thus permitting control of the sample quantity while in operation by changing the piston stroke with an adjusting screw.

Reliable composite samples have been obtained with this sampler over an operating period of 4 years. The bellows type has been retired in favor of the more flexible floating-piston type.

Although this sampler was designed primarily for hydrocarbon service, it could be adapted to other liquids by use of a medium in the sample bomb not soluble with the sample. It also could be used to pump directly into the bomb by proper valving and controls.

Stresses in Cylindrical Pressure Vessels Partially Supported by Soil, by R. T. Gray, W. Boothe, and G. Horvay, Mem. ASME, General Electric Company, Knolls Atomic Power Laboratory, Schenectady, N. Y. 1953 ASME Annual Meeting paper No. **53—A-82** (mimeographed; available to Oct. 1, 1954).

CYLINDRICAL pressure containers occasionally are supported by encasing their bottom portion in concrete. To reduce the bending stresses that develop at the interface where built-in and free portions join, it is not uncommon to introduce a transition zone of partial restraint. Sand of suitable stiffness dammed up to a depth of several shell attenuation lengths forms a buffer layer and splits the single interface—the juncture of built-in and free zone—into two interfaces, the juncture of built-in and partially restrained zone, and the juncture of partially restrained and free zone.

This paper first establishes the formula for sand stiffness in terms of its more familiar characteristic, compressibility; and also gives the formula for metal-band stiffness. Second, the expressions are given for the membrane behavior of the shell in each of the zones, considering the shell to be cut along the interface between each zone. Third, the paper determines the edge moments and edge shears developed at the interfaces which maintain continuity between the shell sections in the three zones. Fourth, the stresses and deformations produced by the edge reactions are calculated and these effects are superposed on the membrane results.

Lubrication

Development and Application of Antiwear Turbine Oil, by A. R. Black, Mem. ASME, Shell Oil Company, New York, N. Y., and T. W. Havely, Shell Oil Company, Wood River, Ill. 1953 ASME Annual Meeting paper No. **53—A-125** (mimeographed; available to Oct. 1, 1954).

HIGHLY loaded reduction gears are being developed for marine use. Antiwear or mild extreme-pressure lubricants are considered essential for the lubrication of these gears and for future progress in gear development. This paper shows that antiwear oils can be developed for reduction gearing without sacrifice in the other characteristics of high-quality steam-turbine oils. Certain chemical compounds may be added to lubricating oils for the purpose of providing a boundary layer that will help resist wear, reduce friction, and prevent seizure. These additive materials usually function by physical adsorption on the metal surface or by chemical reaction with the surface.

The choice of additive materials for use in a specific application depends upon the mechanism to be lubricated. Among the important mechanical considerations are: The nature of the metals (including surface treatment and finish), unit load, sliding speed, and operating temperature. A knowledge of these mechanical factors is necessary to a proper selection of additives from the broad range of extreme pressure and antiwear activity that exists. The rather unstable extreme-pressure additives containing sulphur, chlorine, phosphorus, or lead (usually combinations of these elements) are perhaps most widely known. These materials provide a high level of protection against seizure and find application in hypoid gears where a combination of high load and high rubbing velocity demands formation of a contaminated surface or a low shear-strength film in the area of contact to prevent catastrophic seizure. The low shear-strength layer is formed and removed from the surface as long as the temperature of the contacting surfaces generated by the frictional heat, remains high. The result is the substitution of a low rate of chemical wear for severe destruction of the working surfaces.

Next in order of reactivity and protection are the mild extreme-pressure additives. Additives said to possess mild extreme-pressure properties usually differ from extreme-pressure additives only in degree of reactivity. In many cases the same additives are used but at lower concentrations. Some inherently less reactive materials, however, may fall into this group and not qualify as extreme-pressure additives in any concentration. Many industrial applications exist for lubricants containing additives of this type where some degree of surface protection as well as low corrosivity is required.

The next category, antiwear additives, is usually expected to operate below the range of conditions causing catastrophic seizure. Different mechanisms have been proposed to explain how various antiwear additives protect surfaces; probably the mode of action of broadest practical application is that of chemical polishing. Chemical polishing agents work by forming eutectics with the surface which results in a leveling of surface irregularities and thus an increase in the area of actual contact. Oils containing additives of this type are also valuable in industrial applications where precision parts are expected to have long life without change in critical dimensions.

Finally, the low range of additive activity is represented by polar compounds which are only physically adsorbed on the working surfaces and by those compounds having no affinity for the surface whatsoever but function by polymerizing to build up thick films or by merely having molecular dimensions of such a magnitude as to resist the forces tending to squeeze them out of the contact. These materials have specific uses. They usually promote fluid-film lubrication, decrease friction, protect against damage from shock loading, and reduce wear. They are often used in worm gears as well as spur gears.

Other factors must be considered in the development of antiwear oils in addition to the selection of effective antiwear additives. For instance, in a turbine oil, oxidation stability, demulsibility, and protection against rust and corrosion are all required. Thus several additives may be necessary in compounding a satisfactory oil. This, in itself, results in more problems because the additives must be compatible with each

other. Rust inhibitors, antiwear agents, and antifriction additives, for instance, may compete with each other for the surface and reduce the effectiveness of one, or all. In some cases, however, a synergistic action will exist between additives, while in other instances single additives are capable of dual functions (e.g., rust and wear prevention).

The Hydrodynamic Pocket Bearing, by Donald F. Wilcock, Mem. ASME, General Electric Company, West Lynn, Mass. 1953 ASME Annual Meeting paper No. **53—A-83** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE low power loss of an externally pressurized pocket bearing is accompanied by dependence upon the reliability of the external-pressure source. In this new hydrodynamic pocket-bearing design the required flows and pressures are generated by hydrodynamic action within the bearing. Power loss about half that for conventional thrust bearings is readily achieved. Preliminary operation on bearings of this design has been successful, indicating application in high-speed installations where low bearing loss is desirable, and in machines where a measurement of thrust may be useful. The bearing lends itself readily to a frictionless ball-seat mounting, and the principle may be applied to journal bearings.

Operation in a bearing-test rig and in a 500-kw steam turbine have demonstrated the practicability of this new principle of bearing design. The advantages of its application have been shown to be low power loss, high load capacity, the ability to measure applied thrust, and in conjunction with an integrally designed self-pressurized ball seat, the ability to maintain alignment under operating conditions.

The Influence of Surface Profile on the Load Capacity of Thrust Bearings With Centrally Pivoted Pads, by A. A. Raimondi, Assoc. Mem. ASME, and John Boyd, Mem. ASME, Westinghouse Electric Corporation, East Pittsburgh, Pa. 1953 ASME Annual Meeting paper No. **53—A-166** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE results of the analysis and tests reported in the paper may be summarized as follows:

1 When operating in air, the load capacity of a truly flat, centrally pivoted pad is theoretically zero. Experiments on pads approximately $1^1/_2$ in. $\times$ $1^1/_2$ in. and flat to within 5×10^{-6} in. confirm this prediction.

2 The variation of viscosity of a liquid with temperature accounts for part of the observed load capacity of flat centrally pivoted pads operating with liquid lubricants.

3 The variation of the density of a liquid with temperature accounts for only a small part of the load capacity of flat, centrally pivoted pads operating with liquid lubricants.

4 Convexity, inadvertently obtained in machining and by load and temperature deflections in service, probably accounts for a large part of the observed load capacity of centrally pivoted pads.

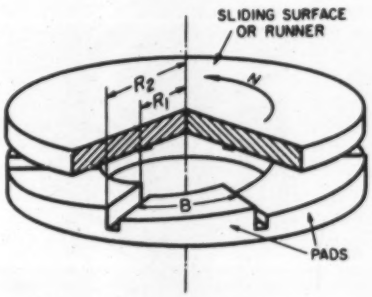
5 Convexity is an important factor in establishing the load capacity of centrally pivoted pads. By controlling convexity, the load capacity of such bearings may, in some cases, be appreciably increased.

6 The optimum amount of crown (or degree of convexity) is about one half the minimum film thickness. Under these conditions a centrally pivoted convex pad is almost equivalent to a flat pad with the pivot located for maximum load capacity.

7 For light loads where elastic and/or plastic deformations of the surface are negligible, a convex pad has an important advantage over a flat pad in being able to start more easily.

Applying Bearing Theory to the Analysis and Design of Pad-Type Bearings, Part I, Fixed-Pad Bearings, Part II, Pivoted-Pad Bearings, by A. A. Raimondi, Assoc. Mem. ASME, and John Boyd, Mem. ASME, Westinghouse Electric Corporation, East Pittsburgh, Pa. 1953 ASME Annual Meeting paper No. **53—A-84** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

IN A previous paper the authors discussed the application of bearing theory to journal bearings. The purpose of the paper was to provide a means whereby designers and other persons concerned with the operation of journal bearings could more easily determine what their theoretical performance would be under various circumstances without being compelled to make an exhaustive study of the subject. The paper relied upon the use of charts and method-of-solution tables to aid in solving for the quantities usually desired. The present paper on fixed-pad bearings follows the same pattern as the one on journal bearings and the charts and tables yield the results to be expected for fixed-pad bearings on the basis of what is generally regarded to be the most usable theory. It is not within the scope of this paper to recommend proper bearing proportions, allowable temperature rises, and so on. These are left to the judgment of the designer to be decided on the basis of experience or test. A second part of the paper applies a somewhat different form of analysis to pivoted-pad bearings.



Sketch of fixed-pad thrust bearing.

Catalytic Action in the Oxidation of Lubricating Oils, by Clayton W. Nichols, Jr., Socony-Vacuum Laboratories, Brooklyn, N. Y. 1953 ASME Annual Meeting paper No. **53—A-244** (mimeographed; available to Oct. 1, 1954).

THE chemical stability of a lubricant in service is dependent, to a large extent, on its resistance to oxygen attack. Study of the oxidation characteristics of lubricating oils, therefore, has been the objective of a great many investigators. Their work has involved research into the mechanism of oxidation of hydrocarbons as well as the effect of various materials on this reaction. This paper deals primarily with the latter problem.

Lubricating oils are subject to contamination and contact with a wide variety of compounds and metals. In industrial use, for example, they are in contact with the metallic components of the lubricating equipment, bearings, gears, and journals. They are also exposed to water, either from condensation or leakage, process materials such as plastics, dirt, soaps, and a host of other things native to industrial usages.

In internal-combustion engines they are exposed to fuel-combustion products in addition to the types of contaminants described above. Some of these are relatively harmless to the chemical stability of the oil. Others, however, have a definite effect on the resistance of the lubricant to oxidation attack. These latter have been grouped into four general classes: Metals, metallic compounds, water, and gases. Some, or all of these materials, are found in lubricating systems.

The extent of their effect on oil stability is the subject of this paper.

Railroad Mechanical Engineering

The Hogan Antiwaste Roll Cavity and Ledge Journal Box, by B. R. Jones, The New York, New Haven and Hartford Railroad Company, New Haven, Conn. 1953 ASME Annual Meeting paper No. 53—A-106 (mimeographed; available to Oct. 1, 1954).

A NEW design of journal box having a small cavity and shaped ledge on each side to prevent rolling waste and thereby prevent hotboxes due to waste grabs has been developed on the New Haven Railroad. It is in service on 1450 New Haven cars. The waste stays in place in all types of operation—humping, heavy switching, general operation of equipment, and in hot and cold weather. The experience in operating cars for a period of six years with this journal box has produced these conclusions in winter and summer. The cold test conducted in the laboratory of the PRR at Altoona, Pa., Feb. 20, 1952, and reported by the AAR Committee, substantiates the cold-weather conditions found in service. The service rendered by this journal box in preventing hotboxes has been highly successful and the one instance of trouble, officially reported, could not be attributed to waste grab caused by displaced waste.

The inside edge of the specially shaped ledge forms the packing line approximately 1 in. below the center line of the journal, insuring that the waste will not be applied too high or too low. The waste-retaining cavity at the mouth end of the box assists in keeping the waste from working out into the mouth of the box. It has been found that the waste requires practically no knifing. This eliminates cutting the waste by the packing iron and the lint stays in the waste as there is only a slight movement of it under the shaped ledge when the direction of the movement of the car is changed and in brake applications. It is only necessary to add oil to these boxes when required; therefore inspection in car yards is fast.

Packing Retainer for Railroad-Car Journal Boxes, by H. J. Stewart, Union Spring and Manufacturing Co., New Kensington, Pa. 1953 ASME Annual Meeting paper No. 53—A-107 (mimeographed; available to Oct. 1, 1954).

THIS paper describes a retainer produced by the Union Spring and Manufacturing Company of New Kensington, Pa. This device is die-formed from spring-steel wire ordered to ASTM specifications, A-229-41, composition B. The blanks are $^{9}/_{16}$ in. diam by approximately 95 in. long. Approximately eight forming operations are utilized before the 16-gage steel clips are clinched into place. The final operation, stress-relieving, removes all forming stresses and stiffens the wire for the severe duty it must perform.

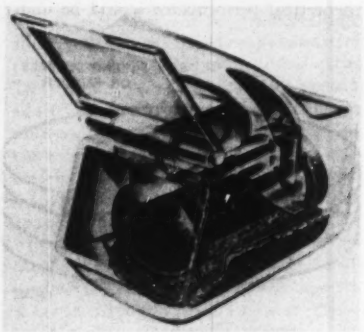
The arms, which are $^{7}/_{8}$ in. wide, provide ample contact with the top of the packing for 5 × 9-in., $5^{1}/_{2}$ × 10-in., and 6 × 11-in. boxes. The grid portion, designed with proper form to hold the waste in a compact condition under the collar, rests in place on the bottom of the box. From this static position the retainer is suitably braced with extensions terminating in corners at the rear side of the wedge stops.

Definite flexibility is provided in these vertical extensions to allow for easy application and removal, also for the difference in the size of the 5 × 9-in. and $5^{1}/_{2}$ × 10-in. boxes which take the combination retainers.

Spring-Type Packing Retainer for Journal Boxes, by M. F. Brunner, Spring Packing Corp., Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-108 (mimeographed; available to Oct. 1, 1954).

THIS paper considers the spring-type packing retainers applied to the journal box to keep the packing from being worked toward the front of the journal box and thereby prevent the packing from settling away from the journal. The device also is designed to prevent the packing from being carried between the journal and bearings in the form of a "waste grab."

The spring-type packing retainer has been designed to hold the packing in position in the journal box. The packing retainer is a spring wire form made from a single strand of wire, clipped together, and stress-relieved after forming to restore the elastic limit. The retainer fits inside the journal box over the packing. It is manufactured from oil-tempered basic spring-steel wire and can be divided into three functioning parts: (1) The horizontal arms resting on the packing parallel to the journal and extending to the rear of the box; (2) the baffle located below the collar against the packing resting on the bottom of the box; and (3) the vertical arms that extend up the side of the journal box over the journal to the wedge hole locking the retainer in its operating position.



View of spring-type packing retainer.

A New Mechanical Oiler for Car Journals, by V. E. McCoy, Mem. ASME, Chicago, Milwaukee, St. Paul, and Pacific Railroad Company, Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-109 (mimeographed; available to Oct. 1, 1954).

A NEW type of mechanical oiling device for railroad-car journals is described. Balls rolling in a specially formed raceway, designed to fit into the bottom of the box and provide contact with the rotating journal, alternately dip into the oil sump and contact the journal to provide the lubrication required.

Lubricator as installed in a journal box.

Comment is also made on the relative merits of the solid-type journal bearing as compared to roller-bearing applications, with particular reference to switching operations. The author believes that solid-bearing equipped cars can be switched more economically than roller-bearing cars. Comment is made on the possibilities of improving the solid-bearing application at relatively low cost to meet the demands of railroad service.

The Ballube, as the device is known, works on the same principle as the ring oiler that has been used for many years.

The accompanying photo shows the Ballube installed in the box. The balls at the upper part of the Ballube are in contact with the under side of the journal. A slot in the top exposes the balls for this purpose. Rotation of the jour-

nal causes the balls to roll around the raceway. As they travel through the lower portion they pass through the oil. A portion of the oil is then carried up to the journal. Openings in the bottom of the castings permit oil to come into the raceway.

The action is similar to that of a pump. The oil is delivered to the journal in a solid stream, without foam or fine spray. As the oil contacts the rotating journal it is carried up to the bearing and is spread from end to end of the bearing in the oil groove. The surplus oil either drops off the edge of the bearing or passes on to the raised portion of the axle at either end, where it is thrown off by centrifugal action.

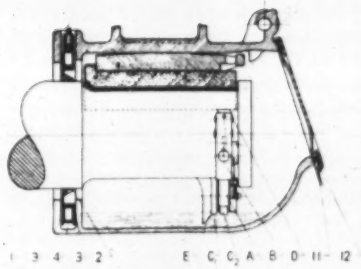
Modernizing Journal Lubrication, by Karl Klingler, Roth Rubber Company, Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-110 (mimeographed; available to Oct. 1, 1954).

ACCORDING to reliable figures, at least 80 per cent of all hotboxes are caused by the waste. This paper shows a new method for adequate journal lubrication by not using waste. Free oil is used which is transferred by simple means from the bottom of the box to the journal. Efficient sealing means are provided to keep the oil in the box. The conversion to this new art of free-oil lubrication can be performed readily on the existing equipment.

A definite aim was to establish the use of a simple lubricating device that would not require costly installation expense yet provide an adequate oil supply to the bearing. In solving this problem, three phases of design were kept in mind.

One phase involved the journal-box lid. The lid, having a metal-to-metal contact with the rough, unmachined face of the journal box, does not seal out the road dirt and moisture; neither does it keep the oil in. The problem of a proper and effective seal was solved in designing a seal of soft, resilient rubber molded around a metal insert, with a built-in breather device, fastened to the lid by means of either spot welding, cold riveting, or by the use of a spring clip.

The rear seal, required in order to use free oil for journal lubrication, presented another design problem. The present rear seal, or dust guard, is a loose-fitting plywood or composition material that does not seal the dust-guard well area. The seal designed uses a hard-rubber sealing ring around the journal and comprises two lips. One lip, in the direction of the interior of the journal box, is designed to keep the oil in. The other lip, extending in the direction of the wheel, has to seal out the road dirt, moisture, or other elements.



Longitudinal section of free-oil lubricated journal box: A, yoke of lubricator; B, clamping arms; C_1, emergency-feed roll; C_2, main-feed roll; D, rolls; E, rubber disk; 1, sealing lip of rear seal; 2, sealing lip of rear seal; 3, flanges of rear seal; 4, hydraulic-pressure tube; 11, lid seal; 12, metal insert in lid seal.

The third problem was to create the means of bringing an adequate supply of lubricating oil to the solid bearing by designing a device that would be low in cost and trouble-free. This problem was met by the design of a device which clamps to the journal and relates only thereto. Rolls, at the lowest point of the journal, transfer oil to the journal, the oil from the journal entering the bearing.

The Plypak—A Resilient, Oil-Resistant Rubber Journal-Box Waste Container and Retainer, by J. W. Hulson, Mem. ASME, Waugh Equipment Co., Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-123 (mimeographed; available to Oct. 1, 1954).

THE Plypak described in this paper has three separate functions.

First, it is a waste container. The Pak is compressed and put in the box and the waste packed into the Pak in the normal manner with standard AAR packing knife according to AAR lubrication manual's instructions or to suit the railroad's standard practice. It has been found desirable to use a back roll made on the spot from loose packing to insure filling the Pak at the fillet end. Additional rolls can be added or the continuous packing method used.

Second, the Plypak is a waste retainer. When the brass is lifted from the journal from car impacts the box rises. When the distance between axle centers is increased by brake action (single brakes), the brass is tipped and the box rises. In both cases the sponging is crowded up on either side of the journal and does not return to normal position until it is again "set up." When these impacts occur with a Plypak-protected box, the sponging is retained by the combs—the resilient portion in the bottom flexes and the waste is forced back to normal position when the journal and brass return to normal.

The Plypak is also a pump. The rolling of the wheel over joints develops vertical action of the box and, since the waste is contained and retained, it is under a constant movement of squeezing and relaxing. This not only pumps oil contained in and under the Pak into the waste but develops a washing or cleaning action which eliminates glazing from the usual accumulation of dirt on the top of the waste.

Hotboxes—Some Fundamental Problems, by J. W. Hawthorne, Mem. ASME, Atlantic Coast Line Railroad Co., Wilmington, N. C. 1953 ASME Annual Meeting paper No. 53—A-104 (mimeographed; available to Oct. 1, 1954).

THIS paper deals with some of the difficulties encountered in the operation of railroad cars, locomotives, and other equipment, with regard to hot journals experienced with friction-journal bearings lubricated by capillary action through cotton-thread waste-type packing. Some of the inadequacies and problems encountered with the present friction-journal assembly and in maintenance practices are outlined. Some suggestions are presented for controlling this situation more effectively. It is noted that much of the data needed to assist in solving the problem are already available. If known and proved corrective action is applied in a practical manner by the railroads collectively, it will be possible to achieve reduction in the numerous accidents and delays to movement of railroad equipment presently attributed to the "hotbox."

Effect of Viscosity on Car Journal Oils on the Running Temperature and Other Characteristics of Journal-Bearing Performance, by W. M. Keller, Mem. ASME, Association of American Railroads, Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-111 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE effect of viscosity in journal oil has been the subject of discussion for many years. Until recent years no data had been obtained with sufficient accuracy and in sufficient quantity to establish the optimum viscosity for oils in the journal box. In more recent years, with laboratory test equipment, it has been possible with controlled conditions to

isolate the oil as a variable and obtain reliable data on this subject.

A consideration of this problem shows that with full hydrodynamic lubrication the asperities of journal and the bearing are separated by a film of oil. There may be minor areas in which this condition does not obtain. However, the general separation of the two surfaces must take place, as it is evident that if large areas of the bearing were in metal-to-metal contact, the wear which results would be of a much higher order and bearing failure more frequent. When bearings have a hydrodynamic film and the metal surfaces are not in contact, the heat developed in a journal box is from two sources: (1) The pressure of the waste against the bottom of the journal and (2) the viscous shear of the oil film between the bearing and the journal.

Effect of Off-Center Brake-Rod Pull on the Performance of Railroad Freight-Car Trucks, by H. T. Rockwell, New York Central System, New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-112 (mimeographed; available to Oct. 1, 1954).

THE effect of off-center brake-rod pull on the skewing of trucks has been analyzed quantitatively by W. H. Sparing with the conclusion that "since the torque transmitted to the brake pull rod is the same order of magnitude as the frictional restraint at the center plate, it does not appear probable that the brake pull rod is a primary factor in truck skewing."

In order to check the results of Sparing's quantitative analysis, two 70-ton-capacity and one 55-ton self-clearing hopper cars were chosen for road tests. One 70-ton car was equipped with the conventional Vulcan-type truck with the bottom brake rod beneath the bolster and the brake pull rod off center $10^1/_4$ in. The other 70-ton-capacity car was equipped with Barber type S-2 trucks with the brake bottom rod running through the bolster. The 55-ton-capacity car had type A-3 "Ride Control" trucks with the brake pull rod $15^1/_2$ in. off center of the car.

The test apparatus consisted of side-frame extensions with indicators centered on a bulls'-eye in the center of a board mounted over the coupler on one end of each car. Motions of the truck side frames in relation to the center line of the center sill and to each other were recorded on movie films. The tests consisted of stopping on tangent track from speeds of 15 and 40 mph with heavy continuous-service reductions and emergency applications of the brakes.

The cars were first tested under capacity loading. When no skewing or nosing of the trucks was caused by brake applications, the tests were repeated with cars running light.

Hotboxes and Train Operation, by G. R. Andersen, Chicago and Northwestern Railway Co., Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-124 (mimeographed; available to Oct. 1, 1954).

THE almost complete failure to provide satisfactory car-journal operation is interfering with the safe and economical operation of the railroads. The reported number of journal failures, set outs, and delays to trains is terrific. While in some territories and on some railroads there are reported improvements in operation, the over-all picture is far from what it should be.

Statistics issued by the Association of American Railroads Monthly show that in the period January to June, 1953, inclusive, there were 72,257 cars set out from trains en route. The miles operated per hotbox were 237,336. While these figures show some improvement over the same period in 1952, with a mileage of 212,813, certainly an average of 12,000 set outs monthly reflects an unhealthy condition.

The dry and hot weather prevalent in the months of June, July, and August and the extreme cold weather in some states during December, January, and February cause a rise in the number of hotboxes. While there might be some letdown in servicing attention during these months, it is of little consequence. The conclusion has been reached that inadequate lubrication is largely a contributing factor. Waste as a lubricator is sensitive to atmospheric conditions. Consequently, the primary consideration is the use of an oil having maximum mobility in its functional relation with waste that will adequately feed oil to the journal under widespread temperatures. Viscosity of the oil is the controlling factor in its rate of feed through the waste. An optimum all-season car oil must have viscosity characteristics that will eliminate the delay time of feeding to the journal on starting and supply an excess of oil to the bearing over the entire range of operating speeds regardless of temperatures encountered.

The author's company uses an oil having a viscosity of 40-42 sec Universal Saybolt at 210 F. Laboratory operating tests and studies indicated that a properly blended and compounded oil having a viscosity 40-42 would have satisfactory mobility in the waste pack under all temperature conditions; would satisfy adequately lubrication in the fluid-film region of lubrication under maximum loads; and would reduce materially the torque in starting and slow-speed operation.

Wrought-Steel Passenger-Car Wheels From a Consumer's Standpoint, by A. M. Johnsen, The Pullman Co., Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-113 (mimeographed; available to Oct. 1, 1954).

FROM a consumer's standpoint, the selection and use of wheels in passenger-car services resolves itself into two fundamental considerations: First, that the class of wheel is assured safe for the kind of operation involved, and second, the matter of economy. Wrought-steel wheels produced by present-day methods of manufacture are adequate upon proper selection to all classes of passenger-train services. However, when we consider the original cost of the wheel and the accumulated charges in the maintenance of the wheel, principally change-out periods and wear limits, the economic aspects become of great importance. These costs constitute a substantial portion of total passenger-car-maintenance cost.

This paper outlines briefly basic considerations in the selection of proper class of wheels for passenger-car services to insure safe operation and discussion of matters pertaining to their economic maintenance. The paper also discusses briefly types of past and present service defects in passenger-car wheels and thermal effects which result from undue braking in certain classes of train operation. In the interest of good wheel maintenance, references are made to established wheel practices of the Association of American Railroads and the economy of proper inspection and turning of the wheels.

Measurement of Stresses Imposed on Wheels in Diesel-Locomotive Service, by L. L. Olsen, Association of American Railroads, Chicago, Ill. 1953 ASME Annual Meeting paper No. 53—A-114 (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE extensive dieselization program being carried on by the railroads has reached a point where wheel failures in this type of service have indicated the desirability of obtaining data on the service stresses they encounter. These failures are different from wheel failures which have been experienced previously in other types of service and are generally characterized by (1) progressive shatter-

ing of rims (oyster-shell fractures), (2) progressive failures occurring through stamping on the rims, and (3) circumferential plate fractures. While the incidence of these failures is low, the occurrence of these types of failures in sufficient numbers has led to the implication that when operating under actual service conditions, diesel locomotives may produce service stresses that are different from those which would be anticipated from the knowledge of weight and other recognized characteristics of this type of equipment.

Tests made on locomotives under field conditions are necessary to secure the type of data needed for an understanding of the forces and stresses imposed on a diesel wheel. A program designed to secure this data has been set up by the Association of American Railroads.

This paper attempts to give a brief description of the objectives and scope of the research program, the test equipment and instrumentation used, the problems involved in carrying out the program, the solutions to date of such problems, and the work that has been accomplished.

Wheel Performance With Disk Brakes, by Paul V. Garin, Mem. ASME, Southern Pacific Co., San Francisco, Calif. 1953 ASME Annual Meeting paper No. **53—A-115** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE use of disk brakes under railroad equipment has materially affected wheel performance. Removal of brake shoes from wheel treads has eliminated the thermal-cracking problem. Another type of defect, so-called "chain sliding," has entered the picture with disk brakes. Selection of the proper class of wheel is important for best performance. This paper discusses briefly the factors involved in the operation of wheels with disk brakes as compared with clasp or on-tread brakes.

Wheel Defects in Equipment With Clasp Brakes, by M. S. Riegel, New York Central System, New York, N. Y. 1953 ASME Annual Meeting paper No. **53—A-116** (mimeographed; available to Oct. 1, 1954).

SHELLING and thermal cracking of multiple-wear wheels in modern diesel locomotives and multiple-unit passenger cars are discussed. Heavier wheel loads and changed requirements of service have resulted in differences from the familiar pattern of wheel defects. Inprovements in the wheel-making art and design changes are necessary to meet current service requirements.

If wheel defects are to be avoided or minimized, careful attention to the design of car or locomotive is necessary to permit use of the largest wheel diameter feasible to reduce unit loading to a point where the available steels in use will not exceed their endurance limits. However, the selection of a wheel design, composition, and heat-treatment for a particular type of equipment always has been a matter of compromise. Steel composition and heat-treatment are dictated by the service requirements. Briefly, the highest possible carbon content and rim hardness are designated to insure maximum wear without thermal cracking.

1.5 Per Cent Carbon Cast-Steel Railroad-Car Wheels, by N. A. Matthews, American Brake Shoe Co., Mahwah, N. J., and R. A. Flinn, University of Michigan, Ann Arbor, Mich. 1953 ASME Annual Meeting paper No. **53—A-118** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

A 1.5 PER CENT carbon cast-steel wheel, designated AARX-2, has been developed for freight-car service after 12 years of research and six years of evaluation by numerous laboratory and field-service tests. Pilot-plant production has been initiated to prove the economics of the process of manufacture. On the basis of two and a half-million car-miles of service under typical and severe conditions wear rate is comparable to that of one-wear wrought wheels. Little tendency for abnormal flange wear has been observed, and a minimum of "shell out" conditions are expected. Dynamometer and service tests have demonstrated conclusively that the wheel overcomes the thermal-checking problem due to brake-shoe action.

Ductility at the 1.5 per cent carbon level is achieved by a combination of close analysis control and a two-stage heat-treatment which produces a pearlitic structure with carbides favorably dispersed. The excess carbide promotes improved wear resistance at a given hardness level.

The Use of Steel Wheels in Freight Service, by Bruce C. Gunnell, Mem. ASME, Southern Railway, Washington, D. C. 1953 ASME Annual Meeting paper No. **53—A-119** (mimeographed; available to Oct. 1, 1954).

THE use of steel wheels as compared to chilled-iron wheels on freight equipment has long been a subject of controversy among both railroad men and wheel manufacturers.

One of the costs which has been quite a debatable subject among certain manufacturers and railroad users of wheels is the comparison of the costs of accidents resulting from chilled-iron wheels as against steel wheels. To this a few basic points will show how this problem can be answered. The AAR condemning limit for a chilled-iron wheel flange is $1^1/_{16}$ in. in thickness, $^3/_8$ in. above the tread. For a steel wheel it is $^{15}/_{16}$ in. This means past practice has shown that the steel-wheel flange is stronger than the chilled-iron wheel.

There has been a recent recommendation due to flange failure on wheels under 70-ton covered hopper cars to prohibit the use of chilled-iron wheels under these cars.

Another fact that should not be overlooked is that diesel and passenger cars are equipped with steel wheels.

Seven years, in general, is figured a good service life for a chilled-iron wheel and $2^1/_2$ times this is a conservative life for a one-wear wrought-steel wheel.

Properties of Metals

The Stress-Rupture Properties of Some Chromium-Nickel Stainless-Steel Weld Deposits, by R. D. Wylie, The Babcock & Wilcox Company, Barberton, Ohio, C. L. Corey, University of Michigan, Ann Arbor, Mich., and W. E. Leyda, The Babcock & Wilcox Research Center, Alliance, Ohio. 1953 ASME Annual Meeting paper No. **53—A-152** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THE data presented on the high-temperature properties of stainless-steel weld deposits indicate that weld metals have, in general, lower rupture strength than wrought materials of corresponding chemical analysis, particularly at temperatures above 1200 F. Deposits which were columbium-stabilized showed better stress-rupture properties than those without columbium. Additional work appears to be necessary to develop welding electrodes suitable for use at temperatures above 1200 F.

The test data show that austenitic weld deposits exhibit low rupture ductility at elevated temperatures as compared with corresponding wrought materials. The significance of this with regard to service requirements is not clear at this time. Recent testing has shown that there may be some possibility of improving the rupture ductility, particularly in short-time tests, by chemical and structural modifications of the austenitic materials.

A testing program for evaluating the high-temperature strength and the residual room-temperature mechanical properties after exposure at elevated tem-

peratures of austenitic welded joints is now being conducted in the laboratories of The Babcock & Wilcox Company. This paper presents the first progress report of the program.

Some 12 Per Cent Alloys for 1000 F to 1200 F Operation, by D. L. Newhouse, B. R. Seguin, and E. M. Lape, General Electric Company, Schenectady, N. Y. 1953 ASME Annual Meeting paper No. **53—A-168** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THIS paper presents a discussion of important engineering properties of some martensitic 12 per cent Cr alloys for use at temperatures up to 1200 F. Detailed high-temperature creep-relaxation and stress-rupture data are given for 12 per cent Cr (Type 403) and for six alloy modifications including 12 per cent Cr-Co-W-V, 12 per cent Cr-W-V, 12 per cent Cr-Mo-V, 12 per cent Cr-Mo-W-V, 12 per cent Cr-Cb, and 12 per cent Cr-Ni-W. Other properties such as thermal expansion, modulus of elasticity, resistance to stress corrosion, and so forth, are discussed.

Some of the modified 12 per cent Cr alloys offer a combination of properties which make them attractive for a number of high-temperature applications.

Results of Service Test Program on Transition Welds Between Austenitic and Ferritic Steels at the Philip Sporn and Twin Branch Plants, by G. E. Lien, Mem. ASME, American Gas & Electric Service Corp., New York, N. Y.; F. Eberle, The Babcock & Wilcox Company, Alliance, Ohio; and R. D. Wylie, The Babcock & Wilcox Company, Barberton, Ohio. 1953 ASME Annual Meeting paper No. **53—A-150** (mimeographed, available to Oct. 1, 1954; to be published in Trans. ASME).

TRANSITION welds between austenitic and ferritic steels have been a source of interest and discussion as to their suitability and strength for high-temperature service. The difference in expansion coefficients has been the main disturbing element which would tend to promote failure of a welded joint under temperature variations.

A test program was set up to give advance operating information on the dissimilar-metal welds installed on the American Gas and Electric Company System in the units of the Philip Sporn Plant of Appalachian Electric Power Company, The Ohio Power Company, and in unit No. 5 of the Twin Branch Plant of the Indiana & Michigan Electric Company. After cycling weld-test vessels, small surface notches and subsurface cracks have formed at the fusion lines between the austenitic weld metal and the ferritic pipe. The program and findings to date are described in this paper.

Cyclic Heating Test of Main Steam Piping Materials and Welds at Sewaren Generating Station, by H. Weisberg, Mem. ASME, and H. M. Soldan, Mem. ASME, Public Service Electric and Gas Co., Newark, N. J. 1953 ASME Annual Meeting paper No. **53—A-151** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

THIS paper describes a continuation of previously reported cyclic heating tests of austenitic and ferritic piping and welds, representing the main steam piping installed at Sewaren Generating Station.

In the current test a section made up of these materials was subjected to thermal cycling from room temperature to 1100 F, and from atmospheric pressure to the operating pressure of 1500 psi. The heating and cooling rates were somewhat more severe than are experienced during regular starting and shutting-down conditions in the actual piping systems. Results show that 100 cycles did not produce any cracking. It is proposed to continue the test to destruction by further cycling and the addition of external bending forces.

Effect of Certain Elements on the Graphitization of Steel, by R. J. Fiorentino, A. M. Hall, and J. H. Jackson, Mem. ASME, Battelle Memorial Institute, Columbus, Ohio. 1953 ASME Annual Meeting paper No. **53—A-153** (mimeographed; available to Oct. 1, 1954; to be published in Trans. ASME).

AN investigation was undertaken to obtain information on (*a*) the relationship, if any, between the aluminum and nitrogen contents of a steel and the susceptibility of the steel to graphitization, (*b*) the manner in which chromium influences the process, and (*c*) the effect of normal amounts of Mn, Si, S, and P in the graphitization of steel.

Twelve laboratory heats of iron-carbon alloy were made from specially prepared melting stock. Various amounts of Al, N, Cr, Mn, Si, S, and P were added to these heats. They were forged to $^5/_8$-in-square bar, variously heat-treated, bead-welded, and tested for graphitization at 1025 F for periods of time extending to 8000 hr.

Information on the progress of graphitization in the specimens was obtained by metallographic examination. The data included the number of graphite nodules per unit area (as a measure of nucleation), the average nodule diameter, and the per cent conversion of carbide to graphite—all as functions of time.

The evidence generally indicated that the graphitization process, whether occurring in the weld-heat-affected zone or in unaffected parent metal, took place by means of a nucleation and growth mechanism, which envisages a time rate of nucleation.

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Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Machining Integral Aircraft Structures

Comment by J. Daugherty[1]

This discussion deals with the equipment for milling integral skins and, particularly, the hypro skin miller of the writer's company. In his paper[2] the author has shown a keen understanding of the machine and has been very generous in attributing some of the difficulties encountered to the original specifications. It seems to be general, with purchasers of large machine tools, that they cannot resist the desire to incorporate in the specifications all the functions that can be conceived. This usually makes it difficult for the designer to provide the necessary functions in the best utility.

In answer to problems raised by the author the following comments are offered:

1 *Feed rates are too slow.* It is assumed that the slow feed rates referred to mean the usable feed rates which are limited by the vertical rate of motion of the hydraulic tracer unit. This rate was originally 50 ipm and was reached without oscillation when the machine was demonstrated originally. Oscillation being a function of the long hydraulic lines and the long mechanical feedback shafts, it is difficult to maintain both in the condition to prevent it. However, on machines with shorter rails this condition disappears. Even on machines of 10-ft width with rails to accommodate two heads the condition is much better.

At present, we are setting up the equipment in our Research Department to test several other tracing systems which will eliminate the long hydraulic lines and mechanical feedback and hope to have a solution in the next few months.

2 *Machines will not hold close tolerance.* Here, the tolerance is mostly a function of the tracing system and improvement of the tracing system will improve the accuracy. The machine proper is of massive and rigid construction and will machine a capacity-size sheet within limits of a few thousandths.

3 *Loading time is excessive.* Recent designs of chucks have incorporated a pattern of lifting plungers which raise the sheet free of the chuck so that a fifing rig can be used. This facilitates loading and unloading.

4 *Cam-changing and positioning are too slow and not accurate.*

5 *Machines have inadequate chip-disposal systems.* A vacuum chip-disposal system which will pick up and dispose of about 95 per cent of the chips has been developed in our Research Department. While it has not been proved in production, we are looking for an opportunity to apply it to a production job.

6 *Machines require excessive maintenance.* The problem of maintenance is mainly one of proper training of the operating and maintenance personnel. There are many more complicated pieces of equipment than a skin mill in everyday satisfactory production. Calculating machines, business machines, printing presses, weaving machines, and many others are operated and maintained. These developments have been made over a long period of time, and, in some cases, it is a special trade to operate and maintain the machines. This can be accomplished with a skin mill if given time and study.

7 *Machines do not provide for quick change and accurate cutter positioning.*

8 *Machines do not have adequate table-positioning equipment.* Techniques are available to provide automatic precision positioning of machine elements. We supply automatic positioning on our horizontal boring mills and it can just as well be made available on a skin mill.

The real trouble with integral-ribbed aircraft skin-milling is the lack of faith of the airframe manufacturers themselves in the process. While the military people and airframe manufacturers practically all admit that the use of milled skins is essential to the manufacture of high-performance aircraft, only one has shown any inclination to finance the development of machines to produce them.

The writer's company is the major producer of skin-milling machines. We either have or have had commitments providing for plowing back every cent of profit on skin mills in research to provide machines to eliminate all the criticism in the author's list. We recently quoted a major manufacturer of military planes on a machine to mill a production integrally ribbed wing panel. The machine was quoted as completely automatic, as to precision cutter, head, table and chuck positioning, providing automatically variable feed rates and machining variable paths without cams or cam changing. Automatic chip pickup and conveying were included. However, we were told that the cost could not be justified on a facilities contract and no funds were available for a development contract.

In addition, the manufacturer thought that milled skins might be superseded by extrusions or even welded-steel constructions in the near future. With this attitude on the part of the airframe manufacturer, one cannot expect a machine-tool manufacturer to spend his own money on development of a skin-milling machine. With all the billions of dollars spent on aircraft development and hundreds of millions spent on forging and extrusion presses and such, skin-milling machines are bought on a dollar-per-pound basis equal to machine tools of equivalent size for long-term industries.

When money is available provision of a highly productive, accurate machine is simple. All the necessary techniques are available and just require a little product improvement.

Comment by A. C. Slatter[3] and G. A. Fairbairn[3]

The author has presented an interesting paper, pointing out some of the problems involved in machining integrally stiffened structures. We at North American can consider ourselves one of the pioneers

[1] Giddings & Lewis Machine Tool Company, Fond du Lac, Mich.

[2] "Machining Integrally Stiffened Structures," by J. C. Borger, MECHANICAL ENGINEERING, vol. 75, November, 1953, pp. 871–874.

[3] North American Aviation, Inc., Los Angeles, Calif.

in this field and are fully in accord with the author's statements regarding material and machine problems.

There is another consideration in the use of this type of structure which we feel should be mentioned. While the utilization of machined integrally stiffened structure is solving many of the problems in modern aircraft, it is well to caution against its wholesale usage by designers. Cost and machine time are two limiting factors which must be considered.

By way of illustration, we would like to point out that four sculptured skins for one of our newer airplanes cost approximately $8400 and there is roughly a loss of 1960 lb of material in machine chips in machining each skin. The foregoing figures should be compared to an approximate cost of $600 and a loss of 170 lb in machine chips on a similar but earlier airplane. In regard to machining time, the four skins for the newer airplane required approximately 160 machine hours using a skin-milling machine in the $200,000 class, as compared to approximately four machine hours required for the skins on the earlier airplane.

The foregoing illustration points out the potential danger of designing ourselves right out of a high rate of production on modern airplanes. As the designers increase the complexity of designs using machine-sculptured structure, the cost and machine hours accelerate upward at a terrific rate. The intelligent application of machined integrally stiffened structure requires close co-ordination between the designer and the machine shop. In this way, the maximum benefits of the new design concept can be utilized without exceeding the limits of practicability.

Comment by K. F. Thornton[4]

The aggressive manner in which the author's company has devised ways and means to utilize the available materials is to be commended. This approach is the basis for progress.

Some attention, we think, always will have to be given to the problem of residual stresses when extensive machining is done. All of the methods we now have, even if they are performed to theoretical perfection, are capable only of reducing the level of residual stresses. None of them brings the stresses right down to zero.

It was most fortunate that the big roller leveler installed in postwar sheet and plate mill of the writer's company for the purpose of producing the flattest possible heavy plate was also capable of eliminating a large part of the residual quenching stresses.

Perhaps it would be in order to say that the writer's company is making some headway in the matter of providing wide, extruded sections which will be suitable for many of these panels. Machining will be greatly reduced and the original stock will be less expensive than plate.

Author's Closure

It is evident that the discussers on "Machining Integrally Stiffened Structures" are aware of the problems and are doing something about them. Since the presentation of the paper considerable progress has been made particularly in the reduction of residual stresses in heavy aluminum-alloy plate.

J. C. Borger.[5]

Batch Weighing

Comment by D. B. Kendall[6]

The author is to be complimented on his thorough and yet concise presentation[7] of the description and operating history of a very interesting batching installation. One feature which has not been mentioned is the requirement that the equipment at the scales must be explosionproof. This is a fairly common condition in the chemical industry, and this particular installation is an example of a good solution to the problems involved. With the type of photoelectric cutoff used, the light source and photocell are housed in enclosures which comply fully with the Underwriters' Laboratory requirements for Class I or II hazardous areas, but the amplifiers, relays, and similar other items can be mounted remotely in a nonhazardous area where they are much more accessible for maintenance purposes.

Proportional Control

Referring to the author's suggestion for a proportional control on the feed valve near the point of cutoff, the main problem is the building of a pneumatic transmitter and controller which will match the accuracy of the weighing scale and provide an easy and highly accurate means of adjusting the cutoff point. An approach to proportional control, which we have used on high-speed weighing applications for over 20 years, is the use of the double or two-speed cutoff. With this equipment the bulk of the material is added at a high rate of speed and, when almost the desired weight is on the scale, the feeder is slowed down so the last few pounds are added at a slow or dribble rate of feed. We suspect that this particular process has been speeded up so the overall time for a single batch is now considerably less than originally specified. This means there is less time available for the weighing operations. If we had known the weighing speed would be such that it would be necessary to set the cutoff point 1 per cent of full scale below the actual weight desired, we definitely would have incorporated the double cutoff control. It would not be difficult to add the necessary equipment to the existing installation so the feed would slow down when the flag or paddle cut the light beam and then stop when the light beam again fell on the photocell. This change would improve both speed and accuracy.

Two-Speed Control

In the case of liquids, two-speed control is achieved either by closing a single valve partially at the first cutoff and closing it completely at final cutoff, or by using two valves in parallel or in tandem with a by-pass around one. One valve closes at the first cutoff and the other at final cutoff. If an air-operated diaphragm valve suitable for throttling control is used, full air pressure to open the valve fully can be used for the fast feed, and reduced pressure to hold the valve partly open can be applied during the slow or dribble feed. Two-speed motors are used for motor-operated feeders.

For electric vibrating feeders, the amplitude of vibration is reduced during dribble feed by the insertion of resistance in series with the feeder coil or by switching from one adjustable transformer to another preset for lower voltage.

Three-Speed Control

Three-speed cutoff control has been used for some fast-weighing applications. It is seldom required in a batching installation, however, because the scales generally can be weighing the next batch while the preceding one is being mixed.

[4] Head, Aircraft Section, Sales Development Division, Aluminum Company of America, New Kensington, Pa.

[5] Production Methods Engineer, Lockheed Aircraft Corporation, Burbank, Calif.

[6] Senior Electrical Engineer, Toledo Scale Company, Toledo, Ohio.

[7] "Batch Weighing for Process Control," by A. H. McKinney, MECHANICAL ENGINEERING, vol. 75, December, 1953, pp. 975–978.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Steel and Iron Materials Handbook

WERKSTOFF-HANDBUCH STAHL UND EISEN (Steel and Iron Materials Handbook. Stahleisen-Verlag, Dusseldorf, Germany, third edition, 1953. Binder, $5^3/_4 \times 8^1/_4$ in., 130 loose leaves, 78 Dm.

Reviewed by W. Trinks[1]

THIS book is a collection of 130 loose leaves bound in a sturdy ring binder. Purchasers of the book are invited to send their addresses to the publisher so that revised sheets may be sent to them.

The book deals with every known property of iron and steel and also with some related subjects. The number of expert authors almost equals the number of leaves. The treatment of each subject is comprehensive and yet compact.

The first group (*A*) contains general information such as specific gravities, atomic weights, periodic system of elements, metric-British conversion tables, tolerances, and so on. The second group (*B* and *C*, *D* and *E*) describes the physical, and a few chemical, properties of iron and steel and the methods of testing them. Corrosion, soldering, hardenability, and machinability are included. The third group (*G* to *L*) shows how properties are affected by production processes and by composition. Almost all of the commonly used alloy-steels are discussed. Even the nonferrous hard metals (carbides) are included. The fourth group (*N* to *Q*) is large. Its title is "Steels for Specific Uses," of which there are 51, including rare uses such as permanent magnets, clad steels, heat-resisting steels, and steels that resist the action of compressed hydrogen. The fifth group (*T* to *Y*) includes heat-treatment and other treatments of steels. Among them are: Hot-working, cold working, machining, protective coatings, metallic, and nonmetallic.

It is impossible in a brief review to do justice to this loose leaf book, which deserves unstinted praise. After reading it carefully from cover to cover this reviewer decided to keep the book rather than follow his usual custom of giving reviewed German books to an engineering library.

[1] Professor emeritus, Carnegie Institute of Technology, Ohiopyle, Pa. Fellow ASME.

Library Services

ENGINEERING Societies Library books may be borrowed by mail by ASME Members for a small handling charge. The Library also prepares bibliographies, maintains search and photostat services, and can provide microfilm copies of any items in its collection. Address inquiries to Ralph H. Phelps, Director, Engineering Societies Library, 29 West 39th St., New York 18, N. Y.

Books Received in Library

AXIALKOMPRESSOREN UND RADIALKOMPRESSOREN. By B. Eckert. Springer-Verlag, Berlin, Germany, 1953. 441 p., 11 × 8 in., bound. 73.50 Dm. This treatise on the application, theory, and calculations of axial and radial-flow compressors presents an extensive review of the fundamentals of modern turbocompressors (except supersonic) as well as detailed treatment of special types. There are also brief chapters on turbomachines under unstable operating conditions and on regulation of compressors. There is an extensive bibliography.

CHAMBER'S SHORTER SIX-FIGURE MATHEMATICAL TABLES. By L. J. Comrie. Chemical Publishing Company, Inc., New York, N. Y., 1954. 387 p., 10 × 7 in., bound. $6.50. Tables essential for purposes requiring more than four-figure accuracy are presented in this volume. Many are reprinted from the two-volume edition, although some have been reset with a wider interval of argument. Among the tables included are logarithms of trigonometrical functions of angles in degrees, minutes, and seconds; trigonometrical functions of angles in degrees, minutes, and seconds; circular functions, or trigonometrical functions with the argument in radians; exponential and hyperbolic functions; and many others.

CLOSED DIE FORGING PROCESS. By P. E. Kyle. The Macmillan Company, New York, N. Y., 1954. 140 p., $8^1/_2 \times 5^3/_4$ in., bound. $1.50. A description of drop-forging processes of possible use as supplementary reading for engineering courses in forging, metal processing, and machine design, and also as a review of the processes for design engineers and users of forgings. The essential steps in producing drop forgings are outlined and some of the uses of closed-die forgings are discussed. Fundamentals of hot-working and the properties of forged metals are also covered. A glossary of forging terms is appended.

COLLECTED PAPERS OF STEPHEN P. TIMOSHENKO. McGraw-Hill Book Company, Inc., New York, N. Y., 1953. 642 p., $9^1/_4 \times 6^1/_4$ in., bound. $15. This volume contains most of Professor Timoshenko's important articles contributed to periodicals in French, German, and English. Some handbook articles are excluded, as are book reviews, discussions of papers, and a few articles more technical than scientific. A list of Timoshenko's early Russian articles and a short biographical sketch are included.

LE CONTRÔLE STATISTIQUE DES FABRICATIONS. By R. Cavé. Éditions Eyrolles, Paris, France, 1953. 430 p., $9^3/_4 \times 6^1/_2$ in., bound. 3950 fr. This practical treatise begins with a section on statistical theory, including the fundamental laws of probability and distribution. Production and quality control are then analyzed in detail, covering sampling, acceptance lots, and other major aspects. The application of statistical methods to research is also dealt with at considerable length. Tables, graphs, and a section of useful monograms supplement the text.

THE CYCLOTRON. By W. B. Mann. John Wiley & Sons, Inc., New York, N. Y., fourth edition, 1953. 118 p., $6^3/_4 \times 4^1/_4$ in., bound. $2. An account of the development of the 37-inch cyclotron at Berkeley, Calif., first published in 1940. In this new edition, minor textual alterations have been made, a chapter has been added covering some of the developments of the past fifteen years, and the bibliography has been brought up to date.

ENGINEERING STEELS. By Leslie Aitchison and William I. Pumphrey. MacDonald & Evans, Ltd., London, England, 1953. 923 p., $8^3/_4 \times 5^3/_4$ in., bound. £5,5 s. The emphasis in this book is on steel from the engineer's point of view: its selection and use for any engineering purpose. The opening chapters deal with processing—melting, casting and hot-working, and heat-treatment. Then follows material on hardenability and mechanical properties, including testing. Plain-carbon, alloy, cold-worked, tool, and other special steels are dealt with separately, as are such subjects as scrap recovery, corrosion, surface hardening, and machinability. Appendixes include a bibliography, British specifications, and other pertinent data.

ÉTUDE DE LA LUBRIFICATION ET CALCUL DES PALIERS. By Lucien Leloup. Dunod, Paris, 1954. 294 p., $9^3/_4 \times 6^1/_2$ in., paper. 2100 fr. An analytical study of the hydrodynamic theory of lubrication of plain bearings, with special attention to friction effects, but restricting the treatment to static load conditions. Both partial and full bushings are treated, distribution and circulation of the oil are considered, and film characteristics are taken into account. Calculations of dimensions, temperatures, and friction coefficients are carried out for several cases.

GEARS. By H. E. Merritt. Sir Isaac Pitman & Sons, Ltd., London, England (available in U. S. from Pitman Publishing Corporation, New York, N. Y.), third edition, 1954. 527 p., $8^3/_4 \times 5^3/_4$ in., bound. $12.50. Written for engineers who design, make, or use gears, this new edition of a standard work approaches the subject of gears and gear action from a general viewpoint. Coverage is simi-

lar to that of earlier editions: gear classification, principles and analysis of tooth contact, geometry and dimensions of main types of gears, the behavior of gears in service, and related topics. The new edition has been extensively rewritten and rearranged, and there is a new chapter on special gear-tooth applications.

GUIDANCE PROCEDURE FOR THE NEW YORK PROFESSIONAL ENGINEERS LICENSE. By John D. Constance, 625 Hudson Terrace, Cliffside Park, N. J., first edition, 1954. 24 p., 11 × 8½ in., paper. $1. This manual, written to aid the engineer seeking a professional license in New York State, can also be used by applicants in other states, since New York procedure and requirements are based on the model law adopted to some extent by other states. Information is included on general procedures, the meaning of qualifying experience, application forms, methods of recording experience, the philosophy and purpose of the written examination, experience requirements for licensure without written examination, etc. Some of the material appeared previously in the journal *Power Engineering*.

HEAT-RESISTING STEELS AND ALLOYS. By C. G. Conway. D. Van Nostrand Company, Inc., New York, N. Y., 1953. 160 p., 8¾ × 5¾ in., bound. $5. This is a compilation of data giving the high-temperature properties of commercial steels and alloys produced in the United Kingdom and the United States. The steels and alloys are grouped in six classes: carbon, low-alloy and martensitic steels; bolt steels; valve steels; U. S. cast steels; standard austenitic steels; and special heat-resisting steels and proprietary alloys. Given for each class are typical composition, common uses, advantages and disadvantages, graphical and tabular creep data, and physical and mechanical properties.

DIE LAPLACE-TRANSFORMATION UND IHRE ANWENDUNG. By Paul Funk, Hans Sagan, and Franz Selig. Franz Deuticke, Vienna, Austria, 1953. 106 p., 8¼ × 5¾ in., paper. $2.40. A brief textbook for engineers and physicists on the application of the Laplace Transform. It is intended to fill the gap between the mathematical treatise and the strictly engineering treatment. A supplement gives a brief history of the development of the subject.

ORGANIC COATING TECHNOLOGY, Volume 1. By Henry Fleming Payne. John Wiley & Sons, Inc., New York, N. Y., 1954. 674 p., 9¼ × 6¼ in., bound. $10. This first volume of a projected two-volume work outlines current theory and practice. There are chapters on fundamentals of film formation, vegetable and marine oils, varnishes, driers, solvents, polymers, and resins. The emphasis throughout is on practical aspects, and there are many specific formulations described. The last chapter surveys test procedures applicable to coatings discussed in the book. A bibliography accompanies each chapter.

ORGANIC PROTECTIVE COATINGS. Edited by William von Fischer and Edward G. Bobalek. Reinhold Publishing Corporation, New York, N. Y., 1953. 387 p., 9¼ × 6¼ in., bound. $7.50. Based on a series of lectures for technicians in the paint industry and the faculty and students of Case Institute of Technology, this book emphasizes the formulation of paints and other organic coatings as engineering materials. Among the subjects covered are the engineering properties of paints, pigment dispersion, reflective properties, hot spray lacquers, emulsion and latex paints, and many specialized coatings.

RUBBER RED BOOK, 1953–1954. Rubber Age, New York, N. Y., 1953. 1190 p., 9¼ × 6¼ in., bound. $10. This new edition of the standard guide to the rubber industry, greatly expanded and revised, lists 1,270 U. S. rubber manufacturers, giving number of employees, officers, and a list of products. There is a separate directory of Canadian manufacturers, and among other sections of the book are lists of accessories and materials suppliers, consulting technologists, sales and export agents, and a who's who of the industry.

STAUANLAGEN UND WASSERKRAFTWERKE. Part 1: Talsperren. By Heinrich Press. Wilhelm Ernst & Sohn, Berlin, Germany, 1953. 212 p., 9½ × 6¾ in., paper. 26.00 DM. Part 1 of a series on dams and hydroelectric generating stations, this volume gives a concise but comprehensive description and analysis of the various types of modern gravity, buttress, and earth dams for both the student and the practicing engineer. The text is supplemented and illustrated by a wide range of examples of existing dams.

STRUCTURE AND PROPERTIES OF SOLID SURFACES. Edited by Robert Gomer and Cyril Stanley Smith. University of Chicago Press, Chicago, Ill., 1953. 491 p. 8½ × 5¾ in., bound. $8.50. The fourteen papers presented here offer a critical review of present knowledge of the physics and chemistry of surfaces under the following broad headings: thermodynamics and theories of surface forces; the structure of a surface and means of determining it; growth processes of and on surfaces; processes on surfaces which leave them relatively unaltered. Some of the specific subjects covered are quantum mechanical theories of surface energy, friction and adhesion, and mechanical properties of crystalline metal surfaces.

TABLES OF CIRCULAR AND HYPERBOLIC SINES AND COSINES. (Applied Mathematics Series, no. 36.) National Bureau of Standards. Distributed by Superintendent of Documents, G.P.O., Washington 25, D. C., 1953. 407 p., 10½ × 8 in., bound. $3. Values of circular and hyperbolic sines and cosines are given to 9 decimal places for a range of x from 0 to 1.9999 at intervals of 0.0001. A few errors in the first two editions have been corrected, and Supplementary Table 3 has been extended, now expressing degrees, minutes, and seconds in terms of radians to 10 decimal places and the reverse conversion to an accuracy of 0.000005 second.

THEORY AND DESIGN OF STEAM AND GAS TURBINES. By John F. Lee. McGraw-Hill Book Company, Inc., New York, N.Y., 1954. 502 p., 9¼ × 6¼ in., bound. $9. Primarily a textbook for senior and graduate mechanical-engineering students, this book has also been written for the practicing engineer familiar with steam turbines who is now concerned with the design of gas turbines. The theory of fluid machinery is treated first and then applied to the design of turbines and axial flow and centrifugal compressors. Two chapters give the fundamentals of thermodynamics and background material in gas dynamics.

TIMBER. Its Structure and Properties. By H. E. Desch. St. Martin's Press, Inc., New York, N. Y., third edition, 1953. 350 p., 9 × 6 in., bound. $6. Written in nontechnical language for the user of wood, this summary of modern wood technology consists of four parts: Parts 1, 2, and 3 cover structure and classification, gross features and identification, and the physical properties of wood; part 4 on wood utilization deals with seasoning, defects, pests, preservation methods, timber grading, and briefly with wood as an engineering material.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting March 5, 1954, and approved by the Board on May 3, 1954.)

CASE No. 1116–3 (*Reopened*)

(*Special Ruling*)

The Boiler Code Committee is considering annulling Case No. 1116–3 (Reopened) (Special Ruling); comments are welcome.

CASE No. 1181

(*Interpretation of Par. P-112(c)*)

Inquiry: Par. P-112(c) makes stress-relief of carbon and carbon-molybdenum steel mandatory in thicknesses appreciably less than those currently permitted under other sections of the Code. May these thicknesses be increased?

Reply: It is the opinion of the Committee that under Par. P-112(c) the

following need not be stress-relieved:

(1) Carbon steel in thicknesses less than $^3/_4$ in.

(2) Carbon-molybdenum steel with carbon not exceeding 0.20 per cent in thicknesses less than $^1/_2$ in.

CASE No. 1183

(Special Ruling)

Inquiry: When copper, copper-silicon alloy, 90–10 cupro-nickel, and 70–30 cupro-nickel plates, sheets, pipes, tubes, and shapes conforming to an approved specification are used for the construction of vessels to be used for external pressure, under what rules shall they be designed and fabricated?

Reply: It is the opinion of the Committee that copper, copper-silicon alloy, 90–10 cupro-nickel and 70–30 cupro-nickel plates, sheets, pipes, tubes, and shapes that conform to an approved specification may be used for the construction of external-pressure vessels and the vessels may be stamped with the Code symbol providing the following requirements are complied with:

(1) The applicable rules in the 1952 edition of Section VIII of the Code covering vessels under external pressure when constructed of nonferrous materials shall be adhered to.

(2) The thickness of shells and heads and the required moment of inertia for stiffening rings shall be determined from the charts in Fig. UNF-28.9 for Annealed Copper Type DHP; Fig. UNF-28.10 for Annealed Copper-Silicon Alloys Type A&C; Fig. UNF-28.11 for Annealed 90–10 Copper-Nickel Alloy; and Fig. UNF-28.12 for Annealed 70–30 Copper-Nickel Alloy and Par. UNF-30.

(*Note:* The above charts are available from the Secretary of the Boiler Code Committee and will also be included in the published Interpretations.)

CASE No. 1184

(Special Ruling)

Inquiry: May annealed aluminum bronze Alloy D seamless condenser tubing with chemical analysis and mechanical properties in accordance with SB-169–52 (plate material) and otherwise conforming to requirements for condenser tubing as given in SB-111-52 be used in the construction of unfired pressure vessels to Section VIII of the 1952 ASME Code?

Reply: It is the opinion of the Committee that annealed aluminum bronze Alloy D seamless condenser tubing conforming to chemical analysis and mechanical properties of SB-169–52 and otherwise conforming to requirements for condenser tubing as given in SB-111–52 may be used in the construction of unfired pressure vessels to the 1952 Section VIII.

The design stresses for aluminum bronze SB-169, Alloy D plate as shown in Table UNF-23, may be used for aluminum bronze Alloy D condenser tubing.

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

AS NEED arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Unfired Pressure Vessels, 1952

PAR. UG-80 Revise to read:

UG-80 *Permissible Out-of-Roundness of Cylindrical Shells* (a) *Internal Pressure* The shell of a completed vessel shall be substantially round. The difference between the maximum and minimum inside diameters at any cross section shall not exceed one per cent of the nominal diameter at the cross section under consideration. The diameters may be measured on the inside or outside of the vessel. If measured on the outside the diameters shall be corrected for the plate thickness at the cross section under consideration (see Fig. UG-80.2).

When the cross section passes through an opening the permissible difference in inside diameters given above may be increased by two per cent of the inside diameter of the opening.

For vessels with longitudinal lap joints the permissible difference in inside diameters may be increased by the nominal plate thickness.

(b) *External Pressure* The shell of a complete vessel to operate under external pressure shall meet the following requirements at any cross section:

(1) The out-of-roundness limitations prescribed in (a).

(2) The maximum plus-or-minus deviation from the true circular form, measured radially on the outside or inside of the vessel, shall not exceed the maximum permissible deviation e obtained from Fig. UG-80.1. Measurements shall be made from a segmental circular template having the design inside or outside radius (depending upon where the measurements are taken) and a chord length equal to twice the arc length obtained from Fig. UG-29.2. The value of t shall be determined as follows:

(a) For vessels with butt joints, t is the nominal plate thickness, less corrosion allowance;

(b) For vessels with longitudinal lap joints the permissible deviation e may be increased by the nominal plate thickness.

(c) Where the shell at any cross section is made of plates having different thicknesses, t is the nominal thickness of the thinnest plate, less corrosion allowance.

Delete Par. UG-80 (c), and change designation of "(d)" to "(c)."

Add new subparagraph (d) to read:

(d) The dimensions of a completed vessel may be brought within the requirements of this paragraph by any process that will not impair the strength of the material.

Re-letter present (f) as new (e), and present (g) as new (f).

Add new subparagraph (g) to read:

(g) An example illustrating the application of these rules for a vessel under external pressure is given in Appendix L (Par. UA-271).

FIG. UG-80.1 Revise the caption to read:

MAXIMUM PERMISSIBLE DEVIATION FROM A CIRCULAR FORM "e," FOR VESSELS UNDER EXTERNAL PRESSURE

FIGS. UG-29.2 and UG-80.1 Revise figures to show ordinate values of D_o/t instead of t/D_o.

FIG. UG-80.2 Revise the caption to read:

EXAMPLES OF DIFFERENCES BETWEEN MAXIMUM AND MINIMUM DIAMETERS IN CYLINDRICAL SHELLS

PAR. UA-6(b)(2) Revise the introductory phrase to read:

(2) Heads of the type shown in Fig. UA-6(b) (no joint efficiency factor is required).

Delete E in formula (a), making it read:

$$(a)\ \text{Head thickness, } t = \frac{5PL}{6S}$$

PAR. UA-6(b)(3) Revise the introductory phrase to read:

(3) Heads of the type shown in Fig. UA-6(c) (no joint efficiency factor is required).

Delete E in formula (a), making it read:

$$(a)\ \text{Head thickness, } t = \frac{5PL}{6S}$$

PAR. UA-6(b)(4) Revise the introductory phrase to read:

(4) Heads of the type shown in Fig. UA-6(d) (no joint efficiency factor is required).

Delete E in formula (a), making it read:

$$(a)\ \text{Head thickness, } t = \frac{5PL}{6S}$$

ASME NEWS

With Notes on the Engineering Profession

A rousing ovation was accorded Lewis K. Sillcox, ASME President, when he was introduced to the audience attending the dinner during the Second Annual ASME Engineering-Management Conference held in Philadelphia, Pa., March 31 and April 1, 1954.

Engineering Managers Face Challenges Presented by Dynamic Economy

Market Survey Used to Develop Technical Program for Conference

THE United States will continue to offer accelerated tax write-offs to provide the incentive for industry to close the 90 goals established by the Office of Defense Mobilization. This announcement by Arthur S. Flemming, Director of the ODM, was contained in a talk opening the second annual Engineering Management Conference which was held on March 31-April 1, in Philadelphia, Pa. The conference was sponsored by the Management Division and the Philadelphia Section of The American Society of Mechanical Engineers.

In the same session, Hector R. Skifter, president, Airborne Instruments Laboratories, challenged the more than 350 engineering managers present by emphasizing the need for intensive research to provide better local transportation, better housing, better methods for communicating and storing information, and more effective means for utilizing the leisure time to provide a strong foundation for our high standard of living.

Problems in a Dynamic Economy

Many problems facing engineering managers in a dynamic economy received attention in the stimulating discussions at the Conference. Increasing the creativity of engineers, more effective presentation of ideas, time and cost planning for engineering projects, incentives for engineers, and executive-development programs for engineers were just a few of the topics studied. In a session devoted to the management of sales engineering, Wroe Alderson, of Alderson and Sessions, pointed out that "What a company really has for sale is its technical knowledge, skills, and facilities . . ." and cited opportunities for companies to increase the effectiveness of their sales effort. In another session, T. A. Marshall, Jr., Mem. ASME, examined the necessary functions of a unity engineering organization and told of the progress being made by the Engineers Joint Council to develop such an organization which will effectively represent the engineering profession and will recognize the value of self-interest, individual and organizational, as a motivating force toward successful and continuing operation.

At the dinner, a novel arrangement was used because of the need for ASME President L. K. Sillcox to get an early train. Dr. Sillcox's talk, "Communications and Civilizations," was presented before the dinner started. The general reaction to this was such that it will be followed in future conferences. Another feature of the dinner was the presentation to Dr. Sillcox of an official welcome from Commissioner Samuel S. Baxter on behalf of the Mayor of the City of Philadelphia.

Market Survey Used as Guide in Program Planning

The technical program for the Conference, as well as the other arrangements, developed from the results of an extensive survey made of those who attended the first Engineering-Management Conference which was held in Detroit in April, 1953. As far as is known, this is the first time that a market survey was utilized in the planning of a Society Conference. The questionnaire was distributed to more than 440 engineering managers and contained information concerning preferred dates, topics, and other features of the Conference. It is anticipated that the same procedure will be used in planning the 1955 Conference which will be held March 30-31 in Cleveland, Ohio. Suggestions for topics and qualified speakers should be sent to Phil Carroll, Fellow ASME, chairman of the Management Division, 6 Crestwood Drive, Maplewood, N. J.

ODM Director Tells What Current Activities Mean

First speaker on the Wednesday morning session was Arthur S. Flemming, Director of the Office of Defense Mobilization, who presented a thorough review of current ODM activities. He stated that the urgent need for the continued activities of ODM was based upon the recognition of the fact that we are still in the age of peril and that there has been no reason to believe that communist Russia has changed its policy directed toward the destruction of freedom institutions throughout the world. The ODM is a staff and co-ordination activity of the National Security Council. Dr. Flemming said its objective was to develop and maintain strong mobilization bases. He pointed out that the Defense Department had provided a list which accounted for 1000 end items, accounting for 80 per cent of the defense spending for which plans are being made to establish existing production facilities. He said that this forward planning will also include provisions for 500 war-supporting items and other items which represent the rock-bottom requirements in a civilian economy. One program being considered by the ODM to maintain a broad industrial base was to develop a hard core of executive technical and skilled personnel thoroughly familiar with the production requirements for defense items. These men would be used to maintain defense production equipment in stand-by conditions.

To reduce the damage from attack, ODM is following a program of facilities dispersion and is supporting the construction of protective facilities by providing 100 per cent accelerated tax write-offs. 4.2 billions of the 6.8 billion-dollar stock-piling goal of critical materials have been accomplished. New sources for other critical materials have been and are being developed in readily accessible countries. Programs to achieve more effective utilization of manpower are being developed to integrate service, selective service, and reserve requirements. A program in the reserves establishing grades of immediately callable reserve personnel and selectively callable reserves is being studied. In concluding his discussion, Dr. Flemming called upon those in attendance for suggestions on aspects of the program in order that the full capacity of American industry could be directed to solving these mobilization problems.

During the same session Hector R. Skifter, president, Airborne Instruments Laboratories, discussed the problem of evaluating our standard of living and its constant growth of leisure time. He said that we may be reaching the saturation point as far as mechanical appliances are concerned and that serious attention must be given to means for more effective utilization of leisure.

Industrial-Research Practices

In examining current industrial-research practices, Dr. Skifter stated that our researchers were spending too much time on components and not enough time on the system. We are doing a better job of feeding our dogs than ourselves. We must produce cures for cancer and the common cold. We need to know more about mental health. Local transportation, communication and storage of information, and housing are other areas in serious need of further study. Dr. Skifter concluded by saying, "Engineers are going to be the leaders of the world, they are leading us down the road. Engineers must be trained in preparation for public leadership."

Industrial Life Affects Life Expectancy

At the Wednesday afternoon session Trafford W. Bigger, Mem. ASME, discussed the impact of the high level of activity our industrial life is having upon the life expectancy of our most capable engineers and executives. He pointed out the need for reducing the stress and frustration factors encountered in many industrial situations as a means of achieving more effective utilization of manpower.

In the same session, Phil Carroll pointed out that engineers must be able to sell their ideas and that there is a good and a bad way for accomplishing this. He stressed the importance of examining the nature and needs of the other fellow so that the selling presentation may be more effective.

EJC and the Engineering Profession

T. A. Marshall, Jr., secretary, Engineers Joint Council, in his talk, "EJC and the Engineering Profession," pointed out the need for unity engineering organization which would provide for contribution to public activities by the engineering profession and at the same time properly represent the individual needs of the engineers. He discussed the history of the development of unity engineering organization, citing the important contributions made by the American Engineering Council for 1920–1940. Since 1941 the Engineers Joint Council has been representing the engineering profession and seeking ways for increasing its effectiveness. The NSPE and EJC have established a joint committee that is investigating the opportunities for closer co-operation between these two major engineering groups.

Engineers Joint Council has been active in many professional areas through its Special Surveys Committee, through the activities of the Engineering Manpower Commission, through the Committee on Employment Con-

Chuckling about one of the incidents that occurred during the ASME Engineering-Management Conference are, *left to right:* Phil Carroll, Fellow ASME, chairman, Engineering-Management Division; T. W. Hopper, engineering manager, Day & Zimmerman, Inc., and member of the Executive Committee, Philadelphia Section, ASME; Prof. Ercole Rosa, Jr., Hofstra College, New York, and secretary, ASME Management Division; Paul C. Smith, chairman, Management Division, Philadelphia Section, and general sales manager, Philadelphia District, Link-Belt Company; and T. S. Fetter, Jr., Mem. ASME, staff engineer, Philadelphia Electric Company.

Some of the speakers who addressed the second annual Engineering-Management conference are, standing, *left to right,* Ercole Rosa, Jr., Speaker W. A. Schmall, General Electric Company; J. J. McCarthy, manager, district sales, Cochrane Corporation; and Speaker A. W. Hanson, director, nuclear reseach laboratories Dow Chemical Company. Sitting in the same order are: Speakers, R. J. Kraut, president, Giddings and Lewis Machine Tool Company; H. G. Ebdon, vice-president, Combustion Engineering, Inc.; and J. J. Grebe, director, nuclear research and development, Dow Chemical Company.

Discussing one of the lighter questions at the Engineering-Management Conference are, *left to right:* Edward G. Uhl, vice-president and chief engineer, The Glenn L. Martin Company; James F. Lincoln, president, Lincoln Electric Company; Chairman George M. Muschamps, vice-president of engineering, Brown Instrument Division, Minneapolis-Honeywell Regulator Company; R. B. Read, planning director, Westinghouse Electric Corporation, and vice-chairman W. E. Belcher, Jr., project and application engineer, Brown Instrument Division, Minneapolis-Honeywell Regulator Company, Philadelphia, Pa.

ditions, and the Committee on Recognition of Specialties. Mr. Marshall added that EJC cannot and will not become a collective-bargaining agency, but that by encouraging initiative, resourcefulness, creativity, and individual incentive among the members of the engineering profession, EJC will provide for the engineer the same virile unity organization found within the medical and legal professions.

Management and Research

The Thursday morning session was devoted to management and research, and C. C. Furness, Mem. ASME, director, Cornell Aeronautical Laboratory, told of seven basic principles of research planning which are used in his laboratory. An essential feature of research planning is provision of funds for internal research which is available for the laboratory personnel to conduct personal research. In the current fiscal year, the percentage of income devoted to this will run somewhere between one and one-half and two per cent. These funds, when properly used, represent the best way known to maintain good esprit de corps and to avoid research sterility. Dr. Furness discussed in considerable detail the procedure for preparation for research proposal and decried the fact that the art of exposition among scientists and engineers is badly in need of bolstering. He also stressed the need for flexibility in planning of research programs and for the utilization of the incremental progress.

John J. Grebe, Mem. ASME, in the same session discussed "Procedures for Evaluating Alternative Research Programs." He cited several areas where fruitful industrial research could be pursued and included among these a need for synthetic coffee. He pointed out that many of our best research efforts are wasted on shortsighted solutions to vital problems and emphasized the need for long-range evaluation of the theoretical potential of developments as a guide to preparation of a goal. This economic evaluation combined with an appreciation for the capabilities of competitors will tend to provide projects which will have the ability to contract risk capital. Another criterion of the project's value is its ability to attract capable men to it.

William A. Schmall, in talking about the program of creative engineering pursued at the General Electric Company, called attention to a number of substantial improvements which resulted from the program. The aim of the program is to train engineers in the more systematic solution of problems and it depends upon delegation of considerable responsibility of design and development to engineers only one or two years out of college. Many of the devices currently used in General Electric appliances resulted from the creative thinking of these young engineers.

Management and Sales Engineering

This session on management and sales engineering was opened by Wroe Alderson with a discussion of the basic expanding trend of our economy. He pointed out that the average increase in industrial productivity from 1939 to date is about 3.3 per cent and that if this growth is continued, our gross national product would rise from 367 billion in 1953 to 477 billion in 1960. The engineer and marketer play vital and complementary roles in providing security and prosperity in this continuing economic advance. He added that the engineer has an important contribution to make to effective industrial selling and he outlined a program of engineering in support of marketing and distribution functions.

Ralph J. Kraut, Mem. ASME, president-general manager, Giddings and Lewis Machine Tool Company, spoke on the topic "Organization and Management of a Sales-Engineering Department." He stressed the importance of effective liaison between the design engineers and distribution. The sales engineer who is familiar with the technical requirements of his company's production, of the performance capacities of his equipment, and the needs of the customers' production processing is able to step into this gap with effective results. Mr. Kraut emphasized the need for supervision of sales-engineering activities and discussed opportunities for increasing their effectiveness.

H. G. Ebdon, Mem. ASME, vice-president, Combustion Engineering Inc., discussed the subject, "Selecting and Training Sales Engineers." Because the sales engineer is in close contact with the customers, he must be carefully selected and trained for his responsibility. Mr. Ebdon discussed the program which was used at his company for the training of sales engineers and pointed out that since 1934, 71.5 per cent of the engineering graduates who had been selected for the training program were still with the company.

Internal Problems Influence Engineering Activities

Opening the Thursday afternoon session which was devoted to internal problems affecting engineering activities, E. G. Uhl, vice-president, The Glenn L. Martin Company, discussed the basic requirements of a sound program for executive development. He stressed the need for providing parallel opportunities for method and progress for engineers in the technical and supervisory fields. The greatest responsibility for development of supervisors lies with their immediate superiors who, by their example, demonstrate good procedure. A program of group appraisal of individual performance together with critical-incidents reports provides a basis for evaluation and guides for individual engineers and supervisors. It is also necessary to properly develop the organizational structure and to keep it relatively flat.

Effective utilization of engineering talents depends upon the opportunities which exist in an organization for developing each in-

dividual's latent capabilities. This statement by James F. Lincoln, Mem. ASME, president, Lincoln Electric Company, summarizes his explanation of the unusual achievements which have taken place at the Lincoln Electric Company. There, each man is able to contribute his ideas and is rewarded in proportion to the value of the idea. As a result of this environment the time required to produce their products has been reduced 10 per cent of what was required 20 years ago. Mr. Lincoln presented details of how they accomplished these results and discussed the incentive program which may compensate superior performance with bonuses as large as 178 per cent of the base pay.

In order to plan engineering activities effectively, there must be a framework consisting of two essential parts: 1, a statement of broad product policies within which the operations will be conducted, and 2, a carefully established set of long-term performance objectives from which the operations are aimed. These conditions were discussed by R. B. Read, director of planning, Westinghouse Electric Corporation, in his paper "Co-Ordinating Engineering Activities in a Complex Organization." He added that the estimated return on assets must be used to evaluate long-range plans. Top management has an important responsibility for co-ordinating sales engineering and manufacturing activities.

Published proceedings were available to all in attendance and now are available to the general public by writing to The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

Availability List for 1954 Management Conference Papers

THE papers in this list are available in separate copy form until Jan. 1, 1955. Please order only by paper *number;* otherwise the order will be returned. Copies of these papers may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Paper No.	*Title and Author*
54—Mgt-1	Wasted Manpower, by T. W. BIGGER
54—Mgt-2	Co-Ordinating Engineering Activities in a Complex Organization, by R. B. READ
54—Mgt-3	How to Sell Your Ideas, by PHIL CARROLL
54—Mgt-4	EJC and the Engineering Profession, by T. A. MARSHALL, JR.
54—Mgt-5	Organization and Management of a Sales-Engineering Department, by RALPH J. KRAUT

Active Professional Divisions Program Jacks Up Section Meeting Attendance

Round-Table Discussions Gain in Popularity; Plan for Other Sections to Follow Presented

THE Rochester, N. Y., Section of The American Society of Mechanical Engineers felt the need for increased meeting activity in order to attract attendance of a greater proportion of the membership. The Section Executive Committee studied the problem and suggested that a separate series of informal discussion meetings be held on specific areas of interest.

In view of the likelihood that the experience of the Rochester Section will interest others who have the same problem, the record of seven years of activity in Professional Division Meetings follows.

Machine and Product Design Group

The Professional Division's program at the ASME Rochester Section came into being in the fall of 1947 with the establishment of the Machine and Product Design Group whose purpose was to conduct round-table discussions on any subject of interest to machine designers. During the 1947-1948 season, seven meetings were conducted with attendance ranging between 30 and 50 engineers per meeting.

The Machine and Product Design Group covered the following general range of subjects: Applied Mechanics, Hydraulics, Machine Design, Metals Engineering, and Rubber and Plastics by ASME Professional Divisions. Pneumatics, electrical controls and equipment, electronic controls, and finishing materials were required subjects to cover the balance of field of interest.

After four years of operation of the Machine and Product Design Group, the success of the series of meetings indicated that another group might have a chance of success and, accordingly, in the spring of 1952 the first meeting of the Process Industries Group was held.

Process Industries Group

The Process Industries Group covers the following general range of subjects: Heat Transfer, Instruments and Regulators, and Process Industries by ASME Professional Divisions; tanks and pressure vessels, chemical-processing equipment, and pumping equipment, required subjects to cover remainder of field of interest.

From this springboard, the 1952-1953 program was broadened to include six meetings for the Machine and Product Design Group, four meetings for the Process Industries Group, and another new group—Plant Engineering—laid out a program of six meetings, making a total of 16 extra meetings for the year!

Plant Engineering Group

The Plant Engineering Group covers the following general range of subjects: Fuels, Oil and Gas Power, and Power by ASME Professional Divisions; power-plant maintenance, buildings and grounds maintenance, electric-power distribution, and air handling and dust collection, required subjects to cover remainder of field of interest.

Management and Production Engineering

As the saturation point still had not been reached, the 1953-1954 program established a fourth group known as Management and Production Engineering and covering the following subjects: Management, Production Engineering, and Materials Handling by ASME

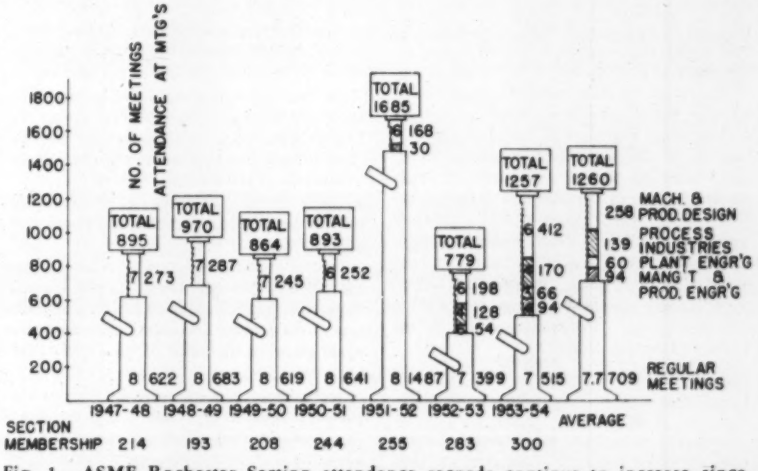


Fig. 1 ASME Rochester Section attendance records continue to increase since active Professional Divisions round-table discussion groups were inaugurated.

Professional Divisions; plant layout, automation, and quality control, required subjects to cover remainder of field of interest.

From these four groups the 1953-1954 progam now in progress plans a total of 17 meetings, divided as follows: Machine and Product Design Group, six meetings; Process Industries Group, four meetings; Plant Engineering Group, three meetings; and Management and Production Engineering Group, four meetings.

The program of these four groups is carried on in addition to the regular series of monthly meetings of the Rochester Section, where the subject matter is usually broader in scope and attendance much larger, due to the arrangement whereby the regular meetings are sponsored jointly by the Rochester Engineering Society and the ASME.

Fig. 1 shows the record of attendance at the various types of meetings held since the inception of this program. It is interesting to note that the increased scope of the program has attracted attendance to the Group meetings without particularly affecting the regular meetings.

Although general attendance has been steady at Group meetings, attendance has fluctuated widely at regular meetings. The figures shown for 1953-1954 have been projected forward to the end of the season. The figures shown as averages are for only the number of years the Group has been in operation.

The conclusions drawn in Rochester from our experiences are that the subdivision round-table discussions are not only worth while as a Section activity but, in fact, are essential to a program which will truly hold the interest of the membership, and experience here indicates that the membership is actually built by such a program.

Round-Table Groups Easy to Organize

The problem of organizing these round-table division groups is much simpler than would ordinarily be thought. Our advice to even a small ASME Section is to scan the membership and to find a nucleus of three to five engineers who are interested and working in a specific field of interest. One of the engineers may be appointed, or elected, as chairman of the group. It was found, in Rochester, that a group of this size would then have no difficulty in attracting other engineers to it, and that if each member of the committee assumed the responsibility to act as moderator, or even speaker, at one of the informal meetings, together they soon would have a program worked out. Groups should not be too large. An attendance of 25 to 35 engineers has been found to be about ideal. If groups get larger, consideration should be given to splitting into two groups. Informality should be the keynote of these meetings.

Local Assistance

Rochester experience indicates that if the local industry are advised of the program, they will wholeheartedly offer meeting-room facilities and, oftentimes, the assistance of the mailing department to send out notices; otherwise, the local Chamber of Commerce, Engineers' Club, University Club, university, or college may be a possible source of free meeting rooms.

The Rochester budget for these extra activities does not normally exceed $25 per Group per year. If the meetings are held in public meeting places where refreshments are not donated by an industry, a small collection is taken to defray costs of simple refreshments, such as coffee and doughnuts, around which the informal discussions are often as valuable as the more formal portions of the meeting.

Membership in the ASME is increased by attracting the engineers who first attend the Round-Table Discussion Groups and find the value so great that they ask to join the Society.

Analysis of the Machine Design Group attendance for 1950-1951 showed that only 35 per cent were ASME members, and 65 per cent nonmembers.

Several visiting engineers who have joined the Society, through interest in the Groups, have since become group chairmen and members of the Section Executive Committee, thus again showing the value of these extra meetings.

We cannot help but urge all Sections to consider broadening their activities along this line and thus prove to themselves the advantages of maintaining an active program of interest, not only to the ASME members, but to the community as a whole.

Nelson S. Hibshman became Secretary of the American Institute of Electrical Engineers on May 1. Mr. Hibshman, who had been assistant secretary of AIEE since Jan. 1, 1953, succeeded H. H. Henline, who had held the post since 1932 and had been assistant secretary prior to that for five years. A former educator and dean of engineering at Pratt Institute of Technology, Mr. Hibshman has been a member of AIEE since 1927, the year he received an MS degree from Lehigh University. He was elected a Fellow of the Institute in 1941. He served the Institute as vice-president from 1941 to 1942; as treasurer, in 1952.

U. S. National Committee World Power Conference

Although the Technical Program has not yet been received from the Brazilian National Committee, the following American papers are being presented at the World Power Conference to be held in Rio de Janeiro, Brazil, July 26–28, 1954.

1 **Natural and Derived Fuels. The Influence of Gaseous Fuels on Modern Industry,** by *Frederic O. Hess*, Mem. ASME, President, Selas Corporation of America

2 **International Water Problems and Progress Made Through Treaties, Compacts, and Agreements,** by *W. A. Dexheimer*, Commissioner, Bureau of Reclamation, Department of Interior

3 **Technical and Economic Principles Involved in Hydroelectric Developments of Common Interest to Canada and the United States,** by *Eugene W. Weber*, Commissioner, U. S. Section, International Joint Commission, Office of Chief of Engineers, U. S. Army

4 **Low-Temperature Carbonization of Lignite for a 240,000-Kw Steam-Electric Power Plant,** by *V. F. Parry*, Chief, Coal Branch, Bureau of Mines, and *W. S. Landers*, Supervising Fuels Technologist, Bureau of Mines

5 **Development of Niagara Falls for Hydroelectric Power—United States and Canada,** by *Francis L. Adams*, Chief, Bureau of Power, Federal Power Commission

6 **The Thermal Power Plant as the Complement of Hydroelectric Developments in Regions of Abundant Hydraulic Potential,** by *Walter Dreyer*, Vice-President and Chief Engineer, Pacific Gas and Electric Co.

7 **Natural and Derived Fuels. The Utilization of Gaseous Fuels by Modern Industry,** by *Virgil Stark*, president, North American Utility and Construction Corp.

8 **Thermal Power as a Complement of Hydroelectric Power in Regions of Large Hydraulic Potential** (based on conditions in Brazil), by *George R. Strandberg*, Chief Hydraulic Engineer, Stone & Webster Engineering Corp., and *J. R. Chapman*, Mechanical Engineer, Stone & Webster Engineering Corp.

9 **Engineering and Economic Problems in the Production of Electric Power From Solar Energy,** by *George O. G. Lof*, Consulting Chemical Engineer

10 **Adequate and Economic Electric Power Essential to a Sound Economy,** by *R. W. Davidson*, Vice-President Charge of Engineering, Ebasco International Corp., and *H. L. Melvin*, Chief Consulting Engineer, Ebasco Services, Inc.

11 **Planning of the Electric Power Industry in Brazil,** by *A. J. Ackerman*, Mem. ASME, Consulting Engineer, Madison, Wis.

Business Opportunities in Atomic Energy Discussed

"Business Opportunities in Atomic Energy" was the theme of the two-day meeting of the Atomic Industrial Forum. An audience of more than 400 attended the sessions which were held at the Biltmore Hotel, New York, N. Y., March 15-16, 1954. Papers were presented at the five sessions which traced the progress made up to date in the atomic-energy field, what is being made available to industry, and what can be expected soon. The meeting was designed to illustrate that there is more in the atom than central-station power, while not detracting from the fact that this field is the "main stream" from which most other developments flow.

The morning and afternoon sessions of the first day were devoted to discussion of uses of radioactive materials in industry and potential industrial applications of atomic energy, respectively. Such subjects as thickness gages, nuclear reactors, an atomic-powered locomotive, utilization of fission products, cold sterilization, and applications in the pharmaceutical industry were considered.

At the evening session, over which W. L.

Cisler, Fellow ASME, president of both the Atomic Industrial Forum and the Detroit Edison Company, presided, five of the country's nonprofit atomic-research facilities available to industry were described. These facilities include: Brookhaven National Laboratory, University of Michigan Phoenix Project, Stanford Research Institute, Battelle Memorial Institute, and Armour Research Foundation.

Consulting nuclear-engineering services were reviewed at the following day's morning session. The government services available to industry were discussed in four papers telling of the Atomic Energy Commission's industrial-participation program, the classification system, its industrial-information services, and the isotopes services.

New materials, such as fluorocarbons and zirconium, were discussed at the early afternoon session. The late afternoon session was given over to four papers on products required by the atomic-energy program: products needed by reactors and related facilities; products required by the AEC; AEC contracting procedures, and how suppliers are assisted in their work with atomic-energy contractors.

The complete forum report is now available at the Forum's main office, 260 Madison Avenue, New York, N. Y., for $6 a copy.

ASME welcomes recently chartered Sacramento (Calif.) Subsection. ASME officers and representatives of other organizations who took part in the charter ceremonies are, *left to right*, seated: R. Robinson Rowe, past-president, Sacramento Chapter, ASCE; W. H. McBryde, past-president, ASME; D. K. Coyle, chairman, Sacramento Subsection, ASME, holding charter; J. N. Landis, chairman, San Francisco Section, ASME; Albert Givan, "Gold Card" Member, ASME, and holder of California Civil Engineers' Registration Certificate No. 1; and R. L. Johnson, past-chairman, San Francisco Section, ASME. Standing, *left to right*, are M. C. Cady, vice-chairman, Sacramento Section, AIEE; E. C. McKinsey, president, Sacramento Chapter, ASHVE; R. F. Kieswetter, president, Grant Technical College; C. D. Allen, president, California Society of Professional Engineers; G. S. Drysdale, vice-chairman, San Francisco Section, ASME; J. W. Walker, past-president, Sacramento Chapter, CSPE; and E. S. Neschke, vice-chairman, Sacramento Section, Institute of Radio Engineers.

1954 Heat Transfer and Fluid Mechanics Institute Program Announced

The seventh annual Heat-Transfer and Fluid-Mechanics Institute will be held at the University of California, Berkeley, on June 30 through July 2.

The program follows:

Registration

8:30–9:30 a.m.

Lobby of Dwinelle Hall, University of California, Berkeley Campus

WEDNESDAY, JUNE 30

9:30 a.m.–12:15 p.m.

Session 1

Preliminary Measurements of Turbulence and Temperature Fluctuations Behind a Heated Grid, by *A. L. Kistler, V. O'Brien, and S. Corrsin,* The Johns Hopkins University

Heat Transfer From Wires at Reynolds Numbers in the Oseen Range, by *J. Cole and A. Roshko,* Guggenheim Aeronautical Laboratory, California Institute of Technology

Investigation of Heat Transfer From Hot Wires in the Transonic-Speed Range, by *H. A. Stine,* National Advisory Committee for Aeronautics, Ames Aeronautical Laboratory, Moffett Field, Calif.

2:15–5:00 p.m.

Session 2

Current Status of Problems of Combustion, by *M. W. Evans,* Stanford Research Institute, Stanford, Calif.

On the Burning of Single Drops of Fuel in an Oxidizing Atmosphere, by *M. Goldsmith,* Daniel and Florence Guggenheim Jet Propulsion Center, California Institute of Technology, Pasadena, Calif., and *S. S. Penner,* California Institute of Technology

Structure and Propagation of Combustion Waves, by *N. Thomas,* Forrestal Research Center, Princeton University

THURSDAY, JULY 1

9:30 a.m.–12:15 p.m.

Session 3

Free-Convection Heat Transfer From a Rotating Horizontal Cylinder to Ambient Air, by *G. A. Etemad,* University of Buffalo

A Method of Measuring Rapidly Changing Surface Temperatures and of Calculating the Surface Heat Transfer Applied to a 40-Mm Gun Barrel, by *W. H. Geidt,* Detroit Controls Corp., Redwood City, Calif.

Heat-Exchanger Design—Relationship Between Heat-Transfer Effectiveness and Pressure Drop, by *D. Aronson,* Worthington Corp., Harrison, N. J.

2:15–5:00 p.m.

Session 4

The Laminar Boundary Layer With Variable Fluid Properties, by *E. R. Van Driest,* North American Aviation, Inc., Los Angeles, Calif.

Similar Solutions of Compressible Boundary-Layer Equations, by *Ting-Yi Li* and *H. T. Nagamatsu,* Guggenheim Aeronautical Laboratory, California Institute of Technology

Three-Dimensional Flow in a Cascade, by *N. Van Le,* AiResearch Manufacturing Co., Los Angeles, Calif.

Time-Dependent Oscillations of a Strong Oblique Shock, by *I. Kaster,* Lockheed Aircraft Corp., Burbank, Calif.

8:00 p.m.

Seminar

Recent movies on two-phase flow and on jet disintegration phenomena.

FRIDAY, JULY 2

9:30 a.m.–12:15 p.m.

Session 5

Matrix Analysis of Heat-Transfer Problems, by *L. A. Pipes,* University of California, Los Angeles, and U. S. Naval Ordnance Test Station, Inyokern, Calif.

The Network Method of Radiation Analysis, by *A. K. Oppenheim,* Shell Development Company, Emeryville, Calif.

Transient Heat Flow in Organic Materials Exposed to High-Intensity Thermal Radiation, by *H. C. Hottel,* Massachusetts Institute of Technology, and *C. C. Williams, 3rd,* Shell Development Company, Emeryville, Calif.

2:15 p.m.–5:00 p.m.

Session 6

The Formation of Gas Bubbles at Horizontal Orifices, by *L. Davidson,* Nuclear Development Associates, Inc., White Plains, N. Y., and *E. H. Amick, Jr.,* Columbia University

On the Stability of a Heterogeneous System, by *C. C. Miesse,* Aerojet-General Engineering Corp., Azusa, Calif.

Experiments in the Air-Stream Atomization Phenomena, by *H. F. Hrubecky,* Iowa State College

1955 INSTITUTE

The 1955 Heat Transfer and Fluid Mechanics Institute will be held in Los Angeles late in June, 1955. The tentative data for submission of papers for the 1955 Institute is Jan. 15, 1955.

Cooper Union to Consolidate Engineering Departments

The Cooper Union School of Engineering will consolidate the work of the departments of mechanical engineering and machine design and engineering drawing into a single department, effective next semester.

Assoc Prof. Kenneth E. Lofgren, Mem. ASME, has been appointed professor of machine design and designated to be in charge of the machine-design and engineering-drawing section of mechanical-engineering department, which will continue under the chairmanship of Prof. William A. Vopat, Mem. ASME. Prof. C. Higbie Young, chairman of the machine-design department for eighteen years, will retire on June 30.

ASME Membership as of April 30, 1954

Honorary Members	51
Fellows	388
Members	14,077
Affiliates	321
Associate Members (33 and over)	3,584
Associate Members (30–32)	3,147
Associate Members (to the age of 29)	16,557
Total	38,125

Representatives of all eight sections attend the fifth annual meeting of ASME Region VIII. Front row, *left to right,* R. A. Bice, Sandia Corporation, Albuquerque, N. Mex.; R. G. Critz, Bethlehem Supply Company, Tulsa; J. M. Zilboorg, Mexico City, D. F., Mex.; H. B. Atherton, Kansas City Power & Light Company, Kansas City, Mo.; and J. K. Richardson, U. S. Bureau of Reclamation, Denver, Colo. Back row, *left to right,* A. H. Jensen, New Orleans Public Service Company; H. H. Meredith, Jr., Humble Oil & Refining Company, Houston, Texas; and J. W. Lacy, Texas Instruments, Dallas, Texas.

At joint Luncheon with the Engineers Club of Tulsa, April 26, during Region VIII meeting. Front row, *left to right,* Harold Grass, secretary, Region VIII; L. K. Sillcox, ASME President; C. H. Shumaker, ASME Vice-President, Region VIII; and H. B. Oatley, chairman, ASME Boiler Code Committee. Back row, *left to right,* W. R. Clarke, Region VIII Meeting Arrangements Committee Chairman; C. E. Davies, secretary, ASME; Ed Byers, President, The Engineers Club of Tulsa; Robert P. Lennart, chairman, Mid-Continent Section, and O. B. Schier, 2nd, assistant secretary, ASME.

ASME Region VIII Triple-Interest Meeting in Tulsa a Big Success

Atomic and solar energy are making strong bids as competitors of coal, oil and gas, and water power and, at least, atomic power will be a competitive actuality within a decade.

This assertion was made by L. K. Sillcox, ASME President, at the joint luncheon meeting with The Engineers Club of Tulsa, in the Chamber of Commerce dining room, one of the many successful events of the fifth annual meeting of Region VIII of the Society. The subject of Mr. Sillcox's talk was "Power and Pipe Lines." The meeting convened on April 25 and continued in technical sessions through April 28. To round out the program there were a number of excellent plant trips and an enjoyable program for the women.

"With improved technology," said Mr. Sillcox, "it is conceivable that electricity can be produced from atomic energy at existing costs of coal-generated electricity."

Nuclear Power to Produce Electricity

The Atomic Energy Commission hopes that by 1960 nuclear power will be supplying electricity in the competitive industrial field, said Mr. Sillcox.

"Between 1960 and 1970, the AEC study shows nuclear power plants will account for 10 to 20 per cent of electric capacity put in place."

The AEC estimated that by the year 2000, about 29 per cent of the installed electric generating capacity is likely to be nuclear and that 50 per cent of new capacity will be nuclear.

"Nuclear energy may delay the development of the direct use of the sun's energy," Mr. Sillcox pointed out, "but eventually solar-energy use will be widespread. At present its chief use is for space heating and this use will continue for some time."

Another Milestone

Increases in the production and utilization of energy by the individual are the milestones of civilization, he said.

If the present rate of increase of energy use continues, the speaker added, it will be nearly doubled by 1975, or the equivalent of burning $2^1/_2$ billion tons of coal per year for the United States alone, nearly the present rate of consumption for the entire world.

Need Management Training

C. V. Elwell, The Western Company, Midland, Texas, viewed the shift of the technically trained man into high places in management as the result of the continued growth of technological advances in industry in his talk entitled, "Engineers Versus Human Beings."

Mr. Elwell spoke Monday night at the joint banquet of senior ASME members with members of the student branches of Region VIII held at Tulsa concurrently with the senior branch. The banquet was at the Mayo Hotel, meeting headquarters.

At the same time, he declared, the fact is that schools do not give the type of training to engineering students which allows them to step into management roles.

"This is the day of the engineer," he stated. "World War II had a tremendous impact upon the technology of business. Since the early 1940's it has become increasingly evident that industrial managers must have some understanding of the technological advances within their businesses."

In spite of all this demand, he pointed out, engineers are finding it difficult to achieve the promotions they desire, chiefly because of lack of management training.

To remedy this condition, he advocated the following:

Change in school curriculums to include management courses.

Specialized training courses by companies to equip engineers to handle management positions.

Carefully planned program of self-improvement by the engineers themselves.

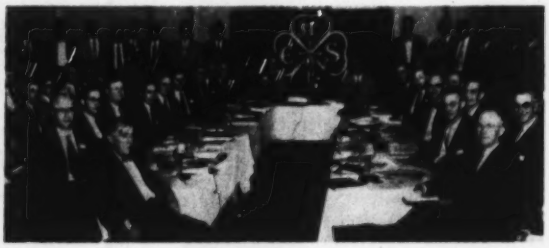
ASME Boiler Code Committee

The meeting of the Boiler Code Committee of The American Society of Mechanical Engineers was held in conjunction with the fifth annual meeting of Region VIII at the Mayo Hotel, Tulsa, Okla., April 25–28. Approximately 250 people attended the sessions which were jointly sponsored.

Technical sessions started at 9:00 a.m., Monday, April 26. This was followed by a luncheon at The Engineers Club of Tulsa in which a welcoming address from the Mayor of Tulsa was read by W. R. Clarke, the general chairman and toastmaster. Speakers were L. K. Sillcox, President of ASME, and H. B. Oatley, Chairman of the ASME Boiler Code Committee.

In the afternoon the sessions continued and meetings of the various ASME Boiler Code Subcommittees were held.

A social hour was followed by a banquet.



ASME Boiler Code Committee in Session.

ASME Student Winners. C. H. Shumaker, second from right, Vice-President ASME, Region VIII, presents a "man-mile" trophy to Everett Hart of Kansas State College, who traveled the greatest number of man-miles to the ASME Student Conference, which was held concurrently with the fifth annual meeting of ASME Region VIII. The other students presented winning papers in competition. *Left to right,* Kenneth May, University of Kansas, third; D. L. Lucke, University of Arkansas, fourth; Daun Whelan, University of Oklahoma, fifth; Mr. Hart, second; Professor Shumaker, and L. W. Ledgerwood, Jr., vice-chairman, Student Membership, ASME Mid-Continent Section. First prize winner, Edward Burkholder, of Oklahoma A&M College, Stillwater, Okla., is not shown.

On Tuesday morning there was a panel session on the various sections of the Boiler and Pressure Vessel Code. Many questions and suggestions were directed to the panel. A number of worth-while suggestions, which resulted from these discussions, are considered acceptable to the subcommittees and will be presented at some future date to the Boiler Code Committee.

Inspection trips for the afternoon were arranged to the American Airlines Maintenance Depot and to the Stanolind Research Laboratories which proved interesting.

On Wednesday an all-day meeting of the Boiler Code Committee convened.

A student conference was held in conjunction with this meeting with Oklahoma University, Oklahoma A&M College, University of Arkansas, Kansas University, Kansas State College, and Nebraska University participating.

A program of activities had been planned for wives and guests touring the many points of interest in Tulsa.

ASME Transactions for May, 1954

The May, 1954, issue of the Transactions of the ASME (available at $1 per copy to ASME members, $1.50 to nonmembers) contains the following:

Technical Papers

Convective Heat Transfer for Mixed, Free, and Forced Flow Through Tubes, by E. R. G. Eckert and A. J. Diaguila. (53—A-191)

Heat Transfer to Mercury in Turbulent Pipe Flow, by H. A. Johnson, W. J. Clabaugh, and J. P. Hartnett. (53—A-189)

Heat Transfer to Lead-Bismuth and Mercury in Laminar and Transition Pipe Flow, by H. A. Johnson, J. P. Hartnett, and W. J. Clabaugh. (53—A-188)

Effect of Single Roughness Elements on the Heat Transfer From a 1:3 Elliptical Cylinder, by R. A. Seban, S. Levy, D. L. Doughty, and R. M. Drake, Jr. (53—A-86)

Heat Transfer in a Gas-Fired Furnace, by S. J. Genna, E. J. Nolan, and A. A. Furczyk. (53—A-190)

A Review of Thermal-Radiation Constants, by N. W. Snyder. (53—A-176)

Radiation in Metals, by N. W. Snyder. (53—A-132)

Thermal-Radiation Tables and Applications, by R. V. Dunkle. (53—A-220)

Local Boiling Heat Transfer to Water at Low Reynolds Numbers and High Pressures, by J. A. Clark and W. M. Rohsenow. (53—A-183)

Tube Expanding and Related Subjects, by F. F. Fisher and G. J. Brown. (53—A-174)

Electronic-Control Method for the Precision Expanding of Tubes, by F. E. Dudley. (53—A-133)

Application of Quality-Control Requirements in Manufacture of Components for a Coaxial-Carrier System, by A. T. Chapman.

On the Theory of Regenerative Chatter in Precision-Grinding Operations, by R. S. Hahn. (53—A-159)

An Experimental Study of Metal Extrusions at Various Strain Rates, by J. Frisch and E. G. Thomsen. (53—A-154)

Cutter Life for Face-Milling Cast Iron, by W. W. Gilbert, O. W. Boston, and H. J. Siekmann. (53—A-149)

Measurement of Stresses Imposed on Wheels in Diesel-Locomotive Service, by L. L. Olson. (53—A-114)

1.5 Per Cent Carbon Cast-Steel Railroad-Car Wheels, by N. A. Matthews and R. A. Flinn. (53—A-118)

Better Yield Through Dimensional Control in Small-Sawmill Operation, by J. S. Bethel. (53—A-199)

A Concept of Fatigue Damage, by S. M. Marco and W. L. Starkey. (53—A-143)

Linkage Design—A Note on One Method, by A. S. Hall, Jr., and D. C. Tao. (53—A-142)

Thermal-Shocking Austenitic Stainless Steels With Molten Metals, by R. A. Tidball and M. M. Shrut. (53—A-179)

Heat-Treatments of Welded Structures for Relief of Residual Stresses With Particular Reference to Type 347 Stainless-Steel Weldments, by W. L. Fleischmann.

Thermal Checking of Wrought-Steel Railway Wheel Material, by H. R. Wetenkamp. (53—A-72)

A Short Method for the Evaluation of the Effect of Some Thermal-Cycle Variations on Steam-Turbine Heat Rates, by S. D. Fulton. (53—A-97)

Experimental Superheater for Steam at 2000 Psi and 1250 F—Progress Report After 12,000 Hours of Operation, by F. Eberle, F. G. Ely, and J. A. Dillon. (53—A-90)

Interface-Extension Versus Upper Limiting Time-Mean Energy-Release Rates of Constant-Pressure Steady-State Combustion Process, by W. J. Wohlenberg. (53—A-103)

Pulverized-Coal-Fired Gasifier for Production of Carbon Monoxide and Hydrogen, by P. R. Grossman and R. W. Curtis. (53—A-49)

ASME Calendar of Coming Events

June 20–24
ASME Semi-Annual Meeting, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers was Feb. 1, 1954)

Sept. 8–10
ASME Fall Meeting, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers was May 1, 1954)

Sept. 13–24
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Commercial Museum and Convention Hall, Philadelphia, Pa.
(Final date for submitting papers was May 1, 1954)

Sept. 26–29
ASME Petroleum Mechanical Engineering Conference, Statler Hotel, Los Angeles, Calif.
(Final date for submitting papers was May 1, 1954)

Oct. 28–29
ASME-AIME Joint Fuels Conference, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers was June 1, 1954)

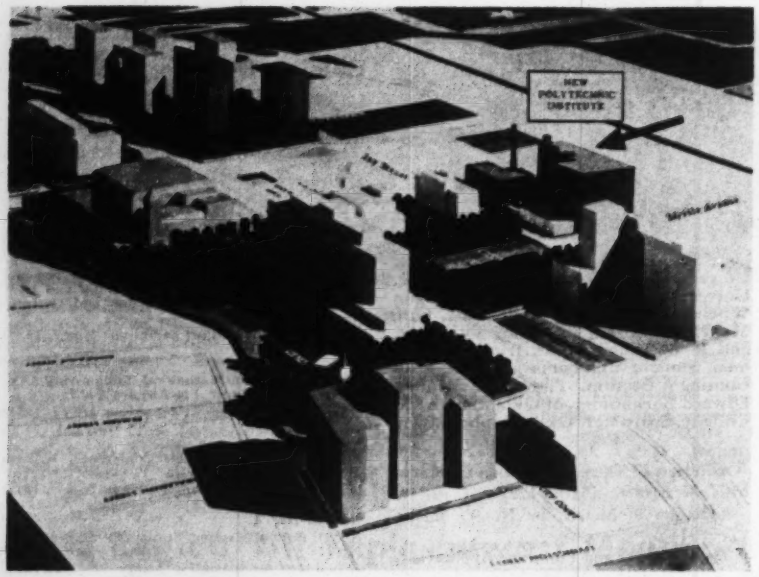
Nov. 28-Dec. 3
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1954)

New Freeman Fund Fellowship Available

Opportunity for research in hydraulics or related fields is available to a qualified applicant of the American Society of Civil Engineers or The American Society of Mechanical Engineers through an award from the Freeman Fund, which offers financial support in the form of fellowships and scholarships. The fund was established by the late John R. Freeman, an outstanding hydraulic engineer, to aid and encourage young engineers to make hydraulic investigations and to undertake hydraulic research. Since Mr. Freeman was president of both ASCE and ASME, it is particularly fitting that members of both societies be eligible for such aid and encouragement.

Notice is hereby given, well in advance of the closing date for submission of applications, of the rules established in connection with application for the award. The rules follow:

1 Applicants must be citizens of the United States and members in some grade of either of



Polytechnic Institute of Brooklyn to occupy new site at Civic Center. Arrow points to the gray models of existing structures of the American Safety Razor Corporation facing Jay Street which Polytechnic Institute of Brooklyn has contracted to purchase for $2 million; $1,500,000 will be spent to convert the buildings. Low white model in front of the two gray structures will be the new Polytechnic Library and Student Lounge. It is expected that conversion of the building will require up to three years. When ready it will be equipped to handle 7500 full and part-time students. The present enrollment, including day, evening, and graduate students, is 6600, making Polytechnic one of the largest engineering schools in the country in terms of enrollment. The new building will have 320,000 ft of floor space and give the Institute 60 per cent more room than it now has. The century-old school has the largest graduate program in America and one of the largest research programs in the United States.

the two co-operating societies, ASCE or ASME.

2 Applications must be submitted to the Freeman Fund Committee, care of the Executive Secretary, ASCE, 33 West 39th Street, New York 18, N. Y., on or before Feb. 1, 1955. Announcement of the award will be made on March 15, 1955.

3 Applicants must tender a program of study, investigation, or research in related subjects, covering a period of at least nine months starting in 1955, together with a statement of funds needed.

4 Applicants must furnish evidence of qualification to carry out the proposed program.

5 The Freeman Award Committee will give preference to projects bearing importantly on the defense effort.

Though $1200 is the usual grant to a winning candidate, the next award can be as much as $3000, depending on the need claimed in the application.

Lubrication Conference Announced

THE Lubrication Activity of The American Society of Mechanical Engineers will hold its first lubrication conference in joint session with the American Society of Lubrication Engineers at the Lord Baltimore Hotel, Baltimore, Md., Oct. 18-19, 1954.

Papers will be sponsored by both societies in five sessions dealing with the following: Journal-bearing behavior and hydrodynamics; recent research results on friction and wear; ball-bearing friction and lubrication; analysis of pressure-viscosity effect in oils; and grease-lubrication studies.

Increased interest in the science of lubrication has created the need for a conference devoted completely to this specific field. This conference will provide an assembly for the presentation and discussion of problems encountered and progress made in the field of lubrication.

Management Book Announced

THE Golden Book of Management, edited for the International Committee for Scientific Management (CIOS) by L. F. Urwich, will be published in London, England, in December of this year.

The book deals with the work, publications, biographical material, and special contribution to management of over 70 personalities from 11 countries whose thinking has become a part of the mental equipment of all serious students of the subject.

A copy of the book may be ordered from First Post, 71 Blandford Street, London W1, England, for $6.50, post-free. Members of organizations affiliated to CIOS may purchase a copy for $5, if ordered before Sept. 1, 1954.

Coming Meetings . .

Engineering Education

THE annual meeting of the American Society for Engineering Education will be held June 14–18, at the University of Illinois. The theme this year, "Evaluation of Engineering Education," will feature a thorough analysis of all phases of engineering education. This will conclude the Society's two-year study of the subject. Industry's view on engineering education will be discussed by several industrial representatives.

The meeting will include conferences sponsored by two component organizations of the ASEE, the Engineering College Administrative Council and the Engineering College Research Council. These groups will also hold a joint dinner to commemorate the fiftieth anniversary of the founding of engineering experiment stations in engineering colleges, a movement that has contributed substantially to research progress in this country.

Educators and engineers from other countries who are visiting in the United States are cordially invited to attend. Foreign guests should write to Prof. R. K. Newton, ASEE Housing Chairman, University of Illinois, Urbana, Ill., for information and reservations.

International Congress on Nuclear Engineering

A WEEK-LONG international meeting which will explore the chemical-engineering aspects of nuclear processes is being planned by the American Institute of Chemical Engineers for the week of June 20–25, 1954, at the University of Michigan, Ann Arbor, Mich.

The program, which is expected to be the most comprehensive ever held on the subject, will begin with a day-long conference on the educational problems associated with training engineers in the nuclear field. A two-day program is planned on the design of nuclear-power reactors, and full technical discussion is scheduled in fuel resources, fuel preparation, chemical processing of spent fuel, disposal of radioactive products, use of isotopes, safety, instrumentation and control, and a conference on the social impact of the atomic age.

Electronic Computors

THE whole of the 1954 British Institution of Radio Engineers Convention, which is to be held at the University of Oxford, July 8–12, will be devoted to the application of electronics to industrial controls, processes, and computation. Over 30 papers are being prepared, but there will be adequate time and facilities for discussion and demonstration. The program is divided into six sessions which include: Industrial applications of electronic computers, electronic methods of testing, and electronic control.

The final session on how electronics can increase production will be opened by Sir Walter Puckey, president of the Institution of Production Engineers. For information wire to the General Secretary, 9 Bedford Square, London, W.C.1, England.

Junior Forum . . .

Conducted by Joseph Schmerler, Assoc. Mem. ASME

Report of National Junior Committee on Section Publications

In August, 1953, the National Junior Committee undertook a study to determine what Associate Members want of ASME. One of the desires concerned the starting of a section publication that would be devoted, at least in part, to the younger members of the Society. The need was felt particularly by Associate Members in the first two or three years after graduation. It is during this period that the graduate is trying to settle in the community. This younger member of the Society wants some means to express himself in his first technical paper, some means by which he can find out more about the men running the Section and announcements of the various meetings, and other items of interest that pertain to his profession. It is in this field that the National Junior Committee is trying to give some information on the ways that these publications can be set up, how they may be run, the personnel that will be required, and the possible editorial content.

Some Sections have publications in effect at the present time. Other Sections are possibly thinking of starting one but do not know how to attack the problem. The National Junior Committee, in preparing this information, is merely offering it to those who might be interested. It is left to each Section to use this information as it sees fit.

Content of the Paper

Several items present themselves immediately for editorial copy.

1 A listing of the meetings that will take place during the period that will elapse between issues of the publication.

2 A short biography of the speaker retained for the main meeting of the group, together with a brief description of the topic for this meeting.

3 A short summary of the main talks given at the meetings of the group during the previous period.

4 An editorial comment by the Chairman of the section.

5 Items of local interest such as meetings of other societies that may appeal to the membership, important civic matters that are of immediate concern to the community, plant-inspection trips, and the like.

6 Items of Society business that have been transacted by the Section Executive Committee.

7 Biographies of the candidates for office proposed by the Section Nominating Committee.

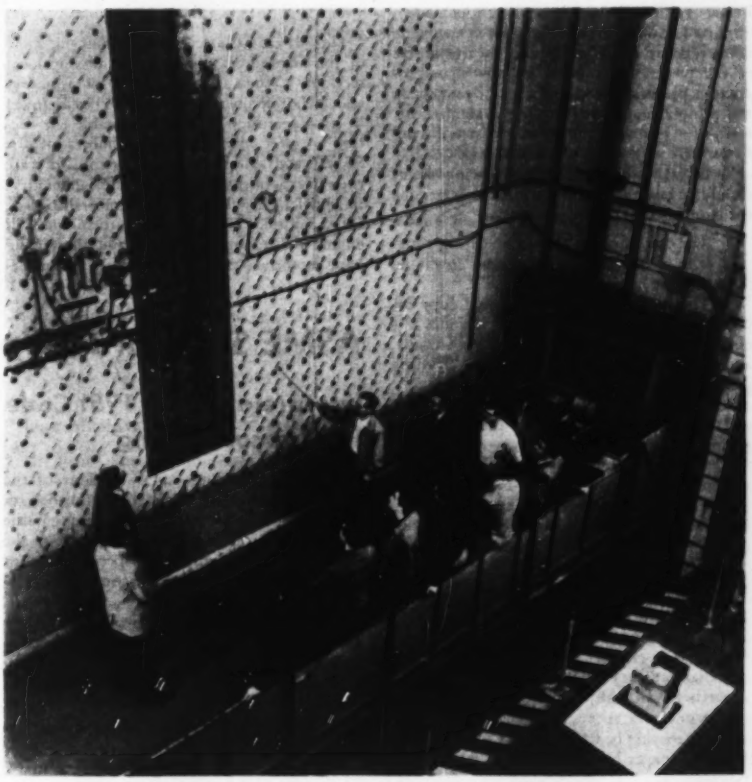
The Editorial Staff

The editorial staff of the section publication could be made a part of the Section Executive Committee. There should be an editor, one or two associate editors, and as many reporters as required. The editor would, of course, be responsible for the over-all operation of the publication. One of the associate editors would be responsible for the collection of the various articles required for each issue. In addition he would be responsible for the format of the issue and delivery of the completed copy to the printer. Another of the associate editors would be responsible for the printing and the distribution of each issue, maintenance of a proper and correct mailing list, and the accounting for funds expended on the various phases of the work. The various reporters would be assigned specific projects and would be responsible for their delivery before a specified deadline date.

Size and Printing Methods

It is only natural to want to start any publication on a large scale, but it may be difficult to maintain it so. Perhaps it would be best to start with a single $8\frac{1}{2} \times 11$ in. page printed on both sides. In this manner the demands for large quantities of copy can be kept to a minimum until the paper has reached a measure of acceptance in the community. After the membership has begun to take an interest in what is being said, the paper can be expanded to take care of the increased demand for more information. It is also quite possible that more people will begin to ask if there is anything they can do to help.

There are several methods of printing that can be used, depending upon such items as the number of copies required from each printing, the quality of printing desired, and last but not least, the amount of money that is available. The least-expensive method of reproduction is by mimeograph machine. This process will give a paper of minimum quality at the lowest cost. Most companies use the mimeograph process in their daily routine of business af-



Features of the massive uranium graphite reactor at Oak Ridge National Laboratory. are explained to a group of students of the Oak Ridge School of Reactor Technology. Tours of the many reactors and engineering facilities of the Laboratory are part of the education provided these students. Oak Ridge National Laboratory is operated by Union Carbide and Carbon Corporation for the U. S. Atomic Energy Commission

fairs. It is however, limited to about 1000 or 1500 copies before the quality of reproduction falls below an acceptable level.

Multilith gives better quality and a larger production run than mimeograph. The price is somewhat higher but has the advantage of clearer copy and and the ability to reproduce pictures, graphs, and other illustrations. It is possible, for example, to reproduce without any trouble freehand sketches of various devices or projects.

The last method to be considered is the regular process using letter type and engravings. This method lends itself to practically unlimited production runs and gives the highest quality work. However, it will be in all probability beyond the modest means of most sections, especially at the start of the publication project.

Of the three general types of reproduction mentioned, the use of multilith will probably be most advantageous. The master copy can be prepared by typewriter and any pictures or illustrations may be pasted to the master. A simple etching process will then transfer the master copy to a metal plate and the page is ready to be printed.

Costs and Advertising

The matter of costs is, like the previous items, rather difficult to determine without first knowing the specific case. One of the indeterminate items is tied directly to the size of the production run. Like any mass-production process, the initial cost of setting up the printed matter is the largest single cost, except for postage, and the unit cost will tend to decrease as the quantity increases.

Specifically, each of the following items should be evaluated before trying to determine the monthly cost of any publication:

1 The cost of office help in preparing copy.

2 The cost of materials, paper, envelopes (if used), ink, and so on.

3 The cost of preparing the final copy for publication and printing. This includes the cost of setting type, or of preparing stencils, and running the paper through the printing process.

4 The cost of addressing the publication and, if envelopes are used, the cost of stuffing them.

5 Postage charges. It is possible to obtain a franking permit from the Post Office Department and have it printed on the publication in that portion set aside for mailing purposes. The Post Office Department should be consulted for further details.

How does one proceed to offset these costs? At the present time the only support that the Society can give is through the regular allotment now in effect. Another source of revenue that presents itself is advertising. Most advertisers, though, expect some return for the money they spend, so that it is suggested that advertising be left for future consideration when the paper becomes accepted in the community.

After eliminating direct help from the Society and revenue from advertising, how then could the paper be supported?

Each Section budgets a portion of the money received from Headquarters to publicity work. These funds could be used to good advantage for the section publication. It is also possible that certain members and organizations in the community would be willing to underwrite a portion of the costs without expecting to receive any advertising or credit for their help. Basically, however, it is a problem that each Section will have to solve for itself within its own organization.

The ASME Research Committee on Corrosion and Deposits from Combustion Gases, shown above, met at the new laboratory of Bituminous Coal Research, Inc., in Columbus, Ohio. Among the subjects discussed was a proposed research project to be sponsored by the committee. Chairman John F. Barkley presided. After the meeting the committee members made an inspection tour of the laboratory. They witnessed a demonstration of a new method for removing sulphur dioxide from stack gases. After lunch, they inspected the facilities of Battelle Memorial Institute.

Summary

This article has attempted to point out some of the advantages of a publication for local sections. When attempted, even on a modest scale, a fair number of persons will be employed in its preparation. This will enable the Section to offer more jobs to members of the Society and should, in the long run, increase the activity of the members in the community. In addition, it will cause the membership to be better informed on events about them and will enable the younger members and those who have recently transferred to the Section to become better acquainted with the activities at home. The range of editorial content of the paper is quite wide and it should not present any great problem to maintain a paper throughout the year. The largest problem to be encountered will be one of cost and financing, but by proper study and management, it can be overcome, especially if the desire for the publication is great enough.

Semi-Annual Meeting, Pittsburgh, Pa. June 22, 1954

The Junior Session will have as its theme the subject, "How Do You Measure Engineering Success?" The speaker will be H. N. Muller, Mem. ASME, assistant to the vice-president—engineering and research, Westinghouse Electric Corporation, Pittsburgh, Pa. The chairman of the session will be A. R. Cederberg, and the vice-chairman will be E. J. Harder, both from Westinghouse Electric Corporation in Pittsburgh.

ASME Standards Workshop . . .

Interpretations of 1951 Code for Pressure Piping

From time to time certain actions of the Sectional Committee B31 will be published for the information of interested parties. While these do not constitute formal revision of the Code, they may be utilized in specifications, or otherwise, as representing the considered opinion of the Committee.

Pending revision of the Code for Pressure Piping, ASA B31.1-1951, the Sectional Committee has recommended that ASME, as sponsor, publish selected interpretations so that industry may take immediate advantage of corresponding proposed revisions.

Case No. 15

Inquiry: May the new ASA B16.5-1953 pressure-temperature rating tables be used in the various sections of the Code for Pressure Piping where reference is now made to applicable American Standard or to ASA B16e?

Reply: It is the Committee's opinion that pending the new edition of the Code for Pressure Piping the pressure-temperature rating tables in ASA B16.5-1953 may be used for all sections of the Code.

Case No. 16

Inquiry: Are the requirements contained in Section 9.3, Specific Minimum Requirements for Refrigerant Pipe and Tubing, of the new Safety Code for Mechanical Refrigeration B9.1-1953 also required by Section 5, Refrigerant Piping of the B31.1 Code for Pressure Piping?

Reply: The Refrigeration Section of the Code for Pressure Piping has taken action to bring the requirements of paragraph 516 into harmony with the new 1953 edition of the B9 Safety Code for Mechanical Refrigeration.

Until such time as a new edition of the Code for Pressure Piping is issued the following wording of paragraph 516 should be complied with.

516 Specific Minimum Thickness Requirements for Refrigerant Pipe and Tubing.

(*a*) STEEL AND WROUGHT-IRON PIPE: Standard wall steel or wrought-iron pipe may be used for design working pressures not exceeding 300 psig, provided lap-welded, electric-resistance-welded or seamless pipe is used for sizes 2 in. and larger and extra strong wall pipe is used for liquid lines for sizes $1\frac{1}{2}$ in. and smaller, conforming to ASA B36.10.

(*b*) STANDARD PIPE SIZE BRASS, COPPER PIPE AND TUBING. Standard pipe size copper and red brass (not less than 80 per cent copper) may be used and shall conform to ASTM Specification B-42 for copper pipe and ASTM Specification B-43 for red-brass pipe.

(*c*) WATER-TUBE SIZE HARD COPPER TUBING. Water-tube size hard copper tubing used for refrigerant piping shall conform to ASTM Specification B-88, Types K or L, for dimension and specifications except that copper tubing with outside dimensions of $\frac{1}{4}$ inches and $\frac{3}{8}$ inches shall have a minimum nominal wall thickness not less than 0.030 inch and 0.032 inch, respectively.

(*d*) SOFT ANNEALED COPPER TUBING. Soft annealed copper tubing used for refrigerant piping shall not be used in sizes larger than $\frac{7}{8}$ inch OD ($\frac{3}{4}$ inch nominal). Soft annealed copper tubing shall conform to ASTM Specification B-68 or ASTM Specification B280T and the minimum nominal wall thicknesses shall be as follows:

Outside diameter, in.	Wall thickness, in.
$\frac{1}{4}$	0.030
$\frac{3}{8}$	0.032
$\frac{1}{2}$	0.032
$\frac{5}{8}$	0.035
$\frac{3}{4}$	0.042
$\frac{7}{8}$	0.045

(*e*) SMALL COPPER TUBING EXCEPTION. Hard copper tubing and soft annealed copper tubing up to and including $\frac{1}{2}$ inch outside diameter used in factory-assembled piping may have wall thicknesses 0.004 inches less than the thicknesses specified in Paragraphs (*c*) and (*d*).

Table 40—List of Material Specifications

Add under TUBING—Nonferrous:

Seamless copper tube for refrigeration field service	ASTM b280T

Table 42—Allowable S values to be used in Formula 13 for Pipe & Tubing in Refrigerant Systems.

Change last three designations as follows:

** Brass pipe, seamless red brass	ASTM B43	7000 lb
** Copper pipe, seamless	ASTM B42	6000 lb
** Copper tubing, seamless	ASTM B88 ASTM B68 ASTM B280T ASTM B75	6000 lb

** Brass pipe, copper pipe, seamless, copper tubing, seamless, temperature limit 250 degrees F.

ASTM B75 not recommended for refrigerant piping.

General Arrangements Committee for the 1954 ASME Fall Meeting to be held at the Hotel Schroeder, Milwaukee, Wis., Sept. 8–10. Milwaukee Section, host for the meeting, will be celebrating its fiftieth anniversary. Seated, *left to right*, E. J. Risseeuw, E. P. Hansen, E. C. Koerper, General Chairman R. D. Teece, R. C. Cramer, and R. B. Adams. Standing, *left to right*, G. V. Miniberger, J. G. Suramcz, A. C. Holmes, A. G. Hoppe, R. J. Sullivan, L. T. Brinson, J. G. Van Vleet, H. G. Holler, and G. F. Leitner.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, April 20, 1954

A MEETING of the Executive Committee of the Council was held in the rooms of the Society, April 20, 1954. L. K. Sillcox, chairman, presided. In addition to Mr. Sillcox there were present: Thompson Chandler, H. E. Martin, A. C. Pasini, and W. F. Thompson of the Committee; Joseph Pope, chairman, Finance Committee; V. Weaver Smith, chairman, Organization Committee; J. L. Kopf, treasurer; E. J. Kates, assistant treasurer; H. R. Kessler, vice-president, F. L. Bradley and R. B. Lea, directors; C. E. Davies, secretary; O. B. Schier, 2nd, assistant secretary; and Ernest Hartford, deputy secretary.

Roy V. Wright Lecture

Selection was approved of Raymond R. Tucker, Mayor of St. Louis, Mo., as the Roy V. Wright Lecturer at the Pittsburgh Semi-Annual Meeting, June 20–24, 1954.

Prime Movers Committee Award

The Prime Movers Committee of the Edison Electric Institute requested the ASME to administer a Prime Movers Committee Award, the purpose of which is "the recognition of outstanding individual or multiple-author contributions to the literature of thermal electric-station practice or equipment." The Executive Committee voted to receive the gift of the Prime Movers Committee Award and to express the appreciation of the Society to the Committee and the contributors to the Fund.

Springer Award

It was reported that Russell S. Springer, Mem. ASME, who died on July 1, 1953, had willed to the Society the sum of $5000, "the income from which permanent fund is to be used for annual awards, medals, or engraved certificates for original outstanding technical papers which are distinct contributions to the literature of the profession of mechanical engineering, These prizes are to be given on recommendation of the proper committee and under the sole jurisdiction of this Society, for the encouragement of the younger members and for the development of the Society."

The Executive Committee voted to receive the legacy of $5000 from the estate of Russell S. Springer and to inform the Board on Honors so that it may administer the Springer Award.

1954 Power Show

The following ASME representatives on the Power Show Advisory Committee for the 1954 Power Show, Dec. 2-8, 1954, were approved: L. K. Sillcox, ASME President; A. C. Pasini, director, Board on Technology; T. R. Olive, chairman, Board on Technology; J. Keith Louden, chairman, Meetings Committee; and C. E. Davies, secretary.

New Engineering Societies Building

At an informal meeting of the representatives of the four Founder Societies and the American Institute of Chemical Engineers, on April 6 in Chicago, Ill., it was recommended that a committee be formed composed of the five presidents to expedite decision on location and other questions concerning the new engineering societies building. The Executive Committee authorized President Sillcox to join with the other presidents in the formation of a committee of the five presidents for this purpose.

In amplification of this action, the Committee stated its understanding that the Committee of Five Presidents as now appointed will continue without change until the project is completed.

The president was authorized to appoint an alternate having equal powers with him, but with the understanding that ASME will have

only one vote on the Committee. The Committee voted to continue the Special ASME Committee on Engineering Societies Building, appointed Dec. 28, 1953.

ASME representatives on the Board of UET will be instructed to ask UET to make a report to the Committee of Five Presidents of progress in implementing the plan outlined in their memorandum, "The Future Home of the Engineering Societies," dated March 5, 1953. These representatives will also be instructed to advise UET of the existence and purpose of the Committee of Five Presidents and to request UET to co-ordinate its operations with the Committee in regard to a new engineering center building.

Student Branches

On recommendation of ECPD, the Executive Committee voted to adopt the following policy with regard to ASME Student Branches:

"Student organizations may be established in schools with engineering curricula accredited by ECPD. The charter of a student organization shall be withdrawn by the governing body of the society concerned in case of withdrawal of ECPD accreditation in the curriculum of the student organization concerned, or for other reasons deemed sufficient for such action.

"Notice of withdrawal by the Society to the student organization and to others concerned shall contain provision for complete dissolution of the student organization not later than three years after such date of notification unless new ECPD accreditation occurs in the interval."

Appointments

The following appointments on Committees and Joint Activities were approved: S. E. Vazquez, Boiler Code Conference Committee; E. O. Bergman, Boiler Code Executive Committee; R. B. Lea, *alternate*, Engineers Joint Council; H. B. Oatley, *alternate*, Engineering Manpower Commission; R. S. Damon, Daniel Guggenheim Medal Board of Award, 3-year term; and R. S. Henry, Committee on Nomination of George Westinghouse for Hall of Fame.

Engineering Societies Personnel Service, Inc.

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members, or nonmembers and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Manager, precision manufacturing, 48, BS and MS degrees. Broad experience in engineering, tooling, methods, cost reduction, management controls, labor, etc. Can develop a strong, profitable organization. Prefers New York metropolitan area. Me-71.

Manufacturers' Representative, assistant, mechanical engineer, 27, BSAE, New York metropolitan area. Two years can manufacturing and three years time standards and product engineering. Fixed salary plus profit sharing. Me-89.

Industrial Engineer, 31, BS(IE), registered PE, seven years' experience comprising wage incentives, methods analyses, materials handling, plant layout, production control, and cost estimating. Present position, plant industrial engineer. Will relocate. Me-90.

Mechanical Engineer, BME, 26, single. Desires position as assistant to engineering or manufacturing executive. Three years' experience as liaison engineer in design, testing, manufacturing, quality control, purchasing, and administration. Location open. Me-91.

Heat-Transfer Engineer, outstanding experience of research in heat transfer, refrigeration, and heating; holds BS, MS, and PhD in mechanical engineering. Desires reponsible position in research or development engineering. Me-92.

Management Mechanical Engineer, BME, 35, family; 15 years' experience with large electrical manufacturing corporation, including experience as follows: graduate-student course in engineering; refrigeration engineering; methods engineering; tool designing; supervision in assembly, electroplating; liaison engineering, etc. Desires position in engineering, management, or manufacturing leading to top position. Me-93.

Executive (Junior), 49, married, registered PE, mechanical, Ala., La., and Ohio. 25 years' experience in field as sales and service engineer in industrial and power-plant equipment. Available May 1, 1954. Prefers South, Southwest, or West Coast. Me-94-544-D-4.

Mechanical-Instruments Engineer, BME, 1944; MME, soon. Eight years in chemical industries; past 5 in measurement and control of process variable. Versed in all phases of plant design. AEC clearance. Me-95.

Mechanical-Sales Engineer, 31, single, BSc (Eng.), mechanical and electrical, Benares Hindu University, India; ME, University of California, Berkeley, Calif. Available within four months after appointment. Location open. Me-96-486-D-4.

Mechanical Engineer, 31, six years' varied experience in production, methods, hydraulic and electromechanical design. Desires position in production or methods engineering. Prefers New York metropolitan area. Me-97.

Mechanical Engineer, proved record of leadership and accomplishment in design, development, and manufacture of mechanical or hydraulic products, special machines, production equipment. Plant modernization. Creative ability. Many patents. Me-98.

Industrial-Mechanical Engineer, 33, PE line and staff. Plant engineering and preventive maintenance, methods, standards, cost-control estimating. Development, metallurgy, machine shop, welding. Familiar with production planning and scheduling. Prefers South. Me-99.

Mechanical Engineer, 32, BSME, married. Six years' experience plumbing-heating field, including design, development, research, engineering sales of automatic valves and controls. Desires position leading to management. Me-100.

Product Design, Mechanical Product Engineer, or Industrial-Design Engineer, 44, married, BSc (Holland), also A.M.I.M.E. (England). Experienced in product design, redesign of existing products, product development, cost reduction, die casting, and metal fabrication. Speaks and reads German, French, and Dutch. Able to head department. Available after June 15th. Prefers West or Eastern Seaboard, Europe. Me-101.

Positions Available

Works Manager, 45–55, engineering degree preferred, proved administrative ability and ten to 15 years' experience in all phases of manufacturing, supervision in plant manufacturing majority of own components of electromechanical nature. Must be production and quality-minded, capable of supervising manufacturing sections, production control, plant maintenance, quality control, and over-all engineering functions, both manufacturing and product engineering. Knowledge of manufacture of traffic appliances preferred. $15,000, plus bonus. Conn. Y-9908-D-9285.

Design Engineer, experience on the design and layout of small industrial elevators. This experience required, in addition to taking over the drafting room and engineering department. $7500. New York, N. Y. Y-9958.

Design Engineer, mechanical degree, at least five years' experience on high-pressure hydraulic and electromechanical devices. Must be citizen and familiar with Navy specifications. $6000–$8000. New York, N. Y. Y-9961.

Design Engineer, design and production experience on small mechanisms to design and follow through production animated-display projects. $6500–$7800. New York, N. Y. Y-9979.

Plant Engineer, 35–45, at least five years' experience in administrative type of engineering and preferably in paper mills. Knowledge of hydraulics helpful. Will handle maintenance, power, and engineering problems for a pulp, paper, and converting mill for a paper manufacturer. $10,000–$12,000. Employer will negotiate fee. Ala. Y-9980.

Project Engineers for quality control, research, and product planning, and development for oven-ready and frozen foods and mixes. $10,000–$15,000. Midwest. Y-9981.

Power-Plant Engineer, BS (ME), preferably with Gold Seal of New Jersey or a comparable license in some other state. Should be able to take complete charge of steam plant at 500-pounds pressure and 150,000 pounds per hour. Should be able to design, install, and maintain boiler equipment. N. J. Y-9984.

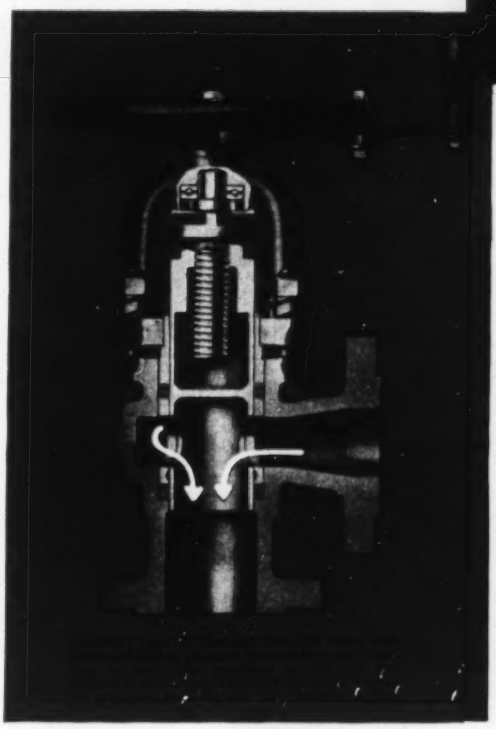
Chief Engineer, mechanical, electrical, civil, or chemical, at least five years' experience in responsible supervisory position and preferably in process industries. Knowledge of pulp-mill operations and pumps. Will direct engineering department comprised of six section heads and their subordinates, to support maintenance, design of new production machinery; some coordination of feeds and output for a paper manufacturer. $8500–$10,000. Employer will negotiate fee. Ala. Y-9987-C-1847.

Designer, mechanical graduate, ten years' metallurgical-equipment and materials-handling experience, to design and lay out automatic-plating facilities and production lines. $7500. Brooklyn, N. Y. Y-9989.

Design Engineer, 30–45, considerable experience in industrial-instrument design such as flow meters, gages, etc. Will head up group of six to

(*ASME News continued on page 558*)

[1] All men listed hold some form of ASME membership.



THIS PRODUCTION "DOUBLE CHECK" SAFEGUARDS YOUR BOILER INVESTMENT!

■ Yes, here is one extra production step we will never bypass! It is your guarantee of a *dependable*, long-life blow-off valve.

In this corner of the YARWAY Testing Department, *every Yarway Blow-Off Valve* is hydrostatically tested at 1½ times its rated maximum working pressure—proved drop-tight for service far beyond normal expectancy.

Not only blow-off valves, but *all* YARWAY equipment undergoes rigorous tests before leaving the YARWAY plant. Why? For one reason—to assure longer and better service in *your* plant. Over 15,000 boiler plants are using YARWAY Blow-Off Valves—some for twenty-thirty years, or longer.

Whenever you are in need of boiler blow-off valves, be sure to *make Yarway your way.*

YARNALL-WARING COMPANY
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY **steam plant equipment**

BLOW-OFF VALVES
WATER COLUMNS AND GAGES
REMOTE LIQUID LEVEL INDICATORS
EXPANSION JOINTS
DIGESTER VALVES
STEAM TRAPS
STRAINERS
SPRAY NOZZLES

eight men. Position is actually design and not administrative. $12,000. New England. V-9995.

Technical Writer, 25–30, engineering graduate, at least two years' mechanical and electrical-equipment experience for writing, sales promotion, and general journalism duties with publicity organization. Some traveling. $6000–$7000. New York, N. Y. W-3.

Assistant Professor or Instructor in mechanics, BS degree, under 30; no experience required. Knowledge of undergraduate statics, dynamics, strength of materials, fluid mechanics. Will teach undergraduate courses in this field and engage in research if available. Opportunity to work toward advanced degree. Position starts September, 1954. $3500–$4500 for nine months. Ill. C-1699.

Research and Development Engineer, mechanical or physics preferred. Three or more years' experience in small mechanisms and especially timers and fuses. Knowledge of horology. Will do research and development, design, and testing of timers and fuses for a manufacturer of clocks. $5500–$9500. Employer will negotiate fee. Ohio. C-1840.

Furnace Designer, 35–45, mechanical or metallurgical engineer, at least eight years' experience in layout and design of industrial furnaces for heat-treating, annealing, or similar purposes. Knowledge of refractories, controls, and conveyers. Will do design and development of industrial furnaces, practically all custom-built, for a manufacturer of furnaces. $7000–$9000. Employer will pay fee. Ill. C-1877.

Project Engineer, mechanical degree preferred, 35–50, ten years' experience in design, drafting, and specification writing. Knowledge of power plants, mechanical services for manufacturing plants, including air conditioning, design, possibly some drafting, specification writing, and reports for a consulting engineer. $7000–$8000. Employer will negotiate fee. Some traveling. Ill. C-1878.

Planning Engineer, 32–50, at least ten years' experience in solid machine-shop background on precision metal-cutting machinery. Knowledge of mechanical-power transmission helpful. Will lay out all machinery and heat-treating equipment; selection of machine tools; design tooling whenever needed and estimate time and cost of manufacturing for a manufacturer of gears. $10,000–$15,000. Employer will negotiate fee. Ill. C-1880.

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after June 25, 1954, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

Key to Abbreviation

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

New Applications

For Member, Associate Member, or Affiliate

ABERNETHY, ROBERT J., New York, N. Y.
ADAMSON, WILLIAM H., New York, N. Y.
ADIA, ANGEL F., JR., Manila, Philippine Islands
AHIMAZ, FRANKLIN J., S. Travancore, India
ALEX, WILLIAM F., Manchester, Conn.
ALEXION, JOHN C., Bayside, N. Y.
ALLEN, JOHN H., Toledo, Ohio
ANDERSON, GLENN W., Oak Park, Ill.
ARIF, MOHAMED N., Manchester, England
BATCHELLER, WILLIS T., Seattle, Wash.
BENJAMIN, GUY F., JR., St. Louis, Mo.
BISHOP, RICHARD H., Los Angeles, Calif.
BLISS, ROBERT HALL, Wenham, Mass.
BOKENKAMP, HARRY J., Urbana, Ill.
BOONSHAFT, JULIUS C., Hatboro, Pa.
BOSSONE, EDMUND D., Havertown, Pa.
BOWEN, RICHARD L., JR., Pawtucket, R. I.
BRADDOCK, JESSE L. S., JR., Margate, N. J.
BRADFORD, GORDON H., Encino, Calif.
BRADLEY, Robert J., Reading, Pa.
BRAGANCA, AUGUST D., São Paulo, Brazil
BRAGG, FRANCIS M., Oak Ridge, Tenn.
BUDGE, ROBERT F., Bristol, Conn.
BUSSE, FLOYD E., Berlin, Wis.
COLMER, ROBERT H., Amarillo, Texas
CURRAN, JOHN V., JR., Yonkers, N. Y.
DAVIES, DONALD, Chicago, Ill.
DEC HAUD, JOHN E., Chicago, Ill.
DENAMUR, NORMAN F., Berlin, Wis.
DISHER, THOMAS, L., JR., Charlotte, N. C.
DIX, EDWARD L., Springfield, Vt.
DOMBROSKI, STEPHEN J., Newark, N. J.
DRISCOLL, JOSEPH B., Mishawaka, Ind.
DUGAN, FRANCIS C., Oak Lawn, Ill.
DUNCAN, ROBERT A., New York, N. Y.
DURRETT, WILLIAM T., Anniston, Ala.
EGGENBERGER, MARKUS A., Schenectady, N. Y.
EIKNER, LEONARD M., Springfield, Pa.
ERDMAN, HARVEY C., Shaker Heights, Ohio
FISHER, DAVID C., Ballston Lake, N. Y.
FLANERY, BAYLES K., St. Louis, Mo.
FOREMAN, A. ROBERT, Ellwood City, Pa.
FORKER, JOHN N., Harrisburg, Pa.
FRANSSEN, HUBERTUS M., Rotterdam, The Netherlands
FRASER, DONALD F., Palmyra, N. Y.
FREED, JACOB B., Dayton, Ohio
FRYER, EDWARD R., Charleston, W. Va.
GAUNT, ROY E., Prospect Park, Pa.
GIBRAT, ROBERT P., Paris, France
GOODMAN, THOMAS P., Cambridge, Mass.
GREEN, CHARLES E., Allegany, N. Y.
GRIEPP, IRWIN H., New Hyde Park, L. I., N. Y.
GRILLO, ELMER V., New York, N. Y.
HAMILTON, WARD L., Rochester, N. Y.
HARTZELL, EDSON K., JR., Denver, Colo.
HERMANN, EUGENE C., Westfield, N. J.
HEVL, HARRY K., Merion, Pa.
HULBERT, DURWARD I., Pittsburgh, Pa.
JANZOW, LESTER G., Whittier, Calif.
JELLIFFE, GEORGE C., New York, N. Y.
JOHNSON, LOUIS H., 3RD, Elgin AFB, Fla
JONES, DANIEL C., Baltimore, Md.
KAJOR, JOSEPH, Erie Pa.
KENNEY, WILLAIM E., Havertown, Pa.
KENT, ROBERT E., Boston, Mass.
KLOTZ, CHARLES H., Haworth, N. J.
KRAUSE, RICHARD P., Butler, Pa.
KROPF, FREDERICK C., Cincinnati, Ohio
KUPSTAS, JOHN, New York, N. Y.
LAFERTY, ROBERT W., Woodbury Heights, N. J.
LAKE, FRANCIS K., Brooklyn, N. Y.
LANGLOIS, HENRY J., Dearborn, Mich.
LANHAM, JOHN W., JR., Chattanooga, Tenn.
LIGHT, ROBERT J., Chesaning, Mich.
LONG, HOLLIS, W., Houston, Texas
LORENC, STANLEY A., Trenton, N. J.
MALGIERI, ANTHONY, JR., Ithaca, N. Y.
MARQUEZ, CARLOS V., Mexico, D. F., Mex.
MARSHALL, JOHN D., Brampton, Ont., Can.
MARTIN, ALEXANDER, Mexico, D. F., Mex.
MCCHESNEY, CUVLER S., Kenmore, N. Y.
MCCONCHIE, WARREN A., Park Forest, Ill.
MCLAUGHLIN, GEORGE S., Coyoacan, D. F., Mex.
MCNALLY, EUGENE, Beaumont, Texas
MELLEN, JOHN F., Hawaii, T. H.
MIKSZTOWICZ, HENRY C., Chicopee, Mass.
MOLLE, RAOUL, Mons, Belgium
MORLEY, GEORGE, Horsham, Pa.
MORROW, DAVID R., Wellsville, N. Y.
NATH, KRISHNARAO V., Madras, India
NOWAK, THOMAS A., Spokane, Wash.
OGLE, GERALD B., JR., Havertown, Pa.
OLIVER, CLAUDIO F., Mesilla, N. Mex.
PINKAVA, WILLIAM A., Cleveland, Ohio
PUCCI, MIGUEL A., New York, N. Y.
REYNOLDS, GEORGE R., Riverdale, Ill.
REYNOLDS, ROBERT K., Danbury, Conn.
RILEY, ELWOOD W., Charleston, W. Va.
ROSE, CLARENCE E., San Francisco, Calif.
ROTH, SEYMOUR, Hartford, Conn.
ROYER, WILLIAM M., Decatur, Ill.
RUSTON, JEFFERY M., Flushing, N. Y.
RYZNAR, JOHN W., Chicago, Ill.
SAYERS, ROBERT P., Chicago, Ill.
SINGLETON, JOSEPH L., Milwaukee, Wis.
SINNER, W. EUGENE, Madison, Wis.
SOMORANO, TOMAS G., Mexico, D. F., Mex.
SPRADLING, JOSEPH W., Madison, Wis.
STELMA, PETER, Shelton, Conn.
STOHR, BERNARD G., Chicago, Ill.
STRIGLE, CHARLES E., Akron, Ohio
SWARTZ, JOSEPH F., JR., Pittsburgh, Pa.
SWENINGSEN, CHARLES A., La Habra, Calif.
TAFT, GEORGE H., Glendale, Calif.
TAYLOR, EDMUND P., Bethlehem, Pa.
THOMPSON, JACK W., Little Rock, Ark.
THOMPSON, RICHARD R., Old Greenwich, Conn.
TITCHNELL, WILLIAM M., Whittier, Calif.
TREADWELL, WARREN D., Willoughby, Ohio
TWOMBLY, ROBERT C., Media, Pa.
WABO, NORMAN S., Adamston, N. J.
WALSH, JAMES F., Port Arthur, Texas
WALTHER, PETER C., Chicago, Ill.
WEISSER, NATHANIEL M., Malverne, L. I., N. Y.
WILLE, HERBERT S., Niles, Mich.
WILLIAMS, WILLIAM E., Chicago, Ill.
WILLSEY, JOHN C., Jonesboro, Ark.
WRIGHT, ZELMA H., JR., Baltimore, Md.

Change in Grading

Transfers to Member, Associate Member, or Affiliate

CASTIGLIONE, CHARLES B., New Orleans, La.
FUSNER, GEORGE R., Scotia, N. Y.
LANKFORD, WILLIAM T., JR., Pittsburgh, Pa.
NARDONE, PIO, Livingston, N. J.
PEACH, ROBERT W., Niantic, Conn.
SCAGNELLI, HENRY J., New York, N. Y.

Transfers from Student Member to Associate Member 423

Obituaries . . .

George William Bach (1877–1954), chairman of the board and former president, American Sterilizer Co., Erie, Pa., died March 13, 1954. Born, Bad-Ems, Germany, April 18, 1877. Parents, Carl C. and Elizabeth (Forster) Bach. Education, public schools; mechanical-engineering training, Illinois Institute of Mechanical Engineering. He served in the U. S. Navy during the Spanish American War in both China and in the Philippine Islands. During World War I he was on the War Service Committee of The American Boiler Manufacturers Association. This Committee made the first complete survey of the United States boiler industry and worked with the Emergency Fleet Division and governmental bureaus in design, construction, allocation of contracts, and expediting flow of boilers and other heavy-plate equipment for Government requirements. He held several U. S. Patents on boilers and pressure vessels. He received the Benjamin Rush Award for outstanding civic work. For many years he was chairman of the Pennsylvania Boiler Advisory Committee of the Department of Labor and Industry. Assoc-Mem. ASME, 1918; Assoc. ASME, 1919; Mem. ASME, 1934; Fellow ASME, 1950. Survived by his wife, Emma Fries Bach; three daughters, Mrs. Harold Schutte, Mrs. Francis Kuhns, and Mrs. Albert Brugger; and four grandchildren.

Raymond O. Bernauer (1890–1953), chief design engineer, 2-Cycle Division, Nordberg Manufacturing Co., Milwaukee, Wis., died Aug. 30, 1953. Born, Wellsboro, Pa., Jan. 16, 1890. Parents, Joseph R. and Wilhemina (Loebich) Bernauer. Education, BS(ME), University of Wisconsin, 1927. Married Mildred Deone Wolfe, 1920. Served in Intelligence Section of 35th Division in World War I; received Purple Heart medal. Mem. ASME, 1944. Survived by wife and three children; Raymond S., San Bernardino, Calif.; Seldon C. and Ruth M., of Milwaukee, Wis.

Willard C. Buttron (1896–1954), superintendent, construction and repairs, Marine Repair Shop, New York Central System, Weehawken, N. J., died Feb. 15, 1954. Born, Albany, N. Y., Feb. 14, 1896. Education, high-school graduate; ICS electrical-engineering courses. Mem. ASME, 1936. Survived by wife, Bertha A. Buttron; a daughter, Mrs. Elsa Schularich, Minneapolis, Minn.; and a brother, G. H. Buttron, Mt. Kisco, N. Y.

Sherman Francis Coghlan (1894–1953), president, J. M. Montgomery & Co., Los Angeles, Calif., died April 25, 1953. Born, Patchogue, N. Y., Oct. 1, 1894. Education, attended Syracuse University. Assoc-Mem. ASME, 1923; Mem. ASME, 1935.

Norman Wheeler Cummins (1881–1953), who was president of Bade-Cummins Manufacturing Co., Louisville, Ky., until his retirement in 1950, died Dec. 12, 1953. Born Waterbury, Conn., Feb. 27, 1881. Parents, Luther W. and Bell A. (Frost) Cummins. Education, high-school graduate; special tutoring. Married Margaret E. Lebzelter, 1916. Mem. ASME, 1918. Survived by wife; a son, Norman W., Jr., and a daughter, Margaret E.

Ernest Ferdinand Du Brul (1873–1954), industrial consultant, executive, and economist, Cincinnati, Ohio, died March 8, 1954. Born, Cincinnati, Ohio, Sept. 12, 1873. Parents, Napoleon and Liliose (Le Gault) Du Brul. Education, University of Notre Dame, Litt. B, 1892; AB, 1893; LLB, 1894; Litt. M, 1894; AM, 1895; studied economics, Johns Hopkins University, 1894–1896. Married Anna McKenzie, 1899 (died 1953). Assoc. ASME, 1900. He was a trustee of the University of Cincinnati; on board of directors, Ohio Mechanics Institute. He was general manager, National Machine Tool Builders Association, 1920–1931. Survived by six daughters, Liliose J., Denise B., Mrs. Mary Sayre, Newtown, Ohio; Sister Mary Ernestine, Dunbarton College, Washington, D. C.; Mrs. Marjorie Shiels, Cincinnati, Ohio; and Sister Mary Marcella, in Pakistan; and three sons,

(*ASME News continued on page 560*)

REVERE METALS

SERVE

Chris-Craft

STEM TO STERN

Bending a Revere Copper Tube for use in a Chris-Craft Cruiser. Revere Tube is also used in many Chris-Craft runabouts and utilities.

Chris-Craft cruisers are protected at the stem by brass stem bands; Revere supplies half-round extruded shapes for this decorative and protective application. At the stern or transom, copper exhaust tubes are just visible. There is a story behind these tubes, which have to be bent to shape with great accuracy, and without wrinkling. Chris-Craft Corporation's specifications are most exacting. The bending is done by a specialist, the Melville-Lee Co., located in Algonac, Mich., as is Chris-Craft. When Revere sought an order for the copper tube, the Technical Advisory Service was permitted to study Melville-Lee's equipment and methods, so our Methods Department at the mill could be thoroughly informed of the high quality requirements.

The tube required runs in sizes from 2" to 3½" OD. Use of copper tube reduces weight, while the corrosion-resisting qualities of copper make it durable and long lasting. Special standards of control over roundness, eccentricity and temper were set up in our mill, and production shipments have worked perfectly from the very beginning. No wrinkling or tearing has been encountered.

• • •

Revere Metals not only serve afloat, but in the air, under the sea, and on land, in almost every industry, including such diverse ones as the chemical, automotive, electrical and electronic, and in the home. Products include tube and pipe, rod and bar, sheet and plate, strip, extruded shapes, forgings, in copper and its alloys and aluminum alloys. Also Lockseam Tube electric welded steel tube. Get in touch with the nearest Sales Office.

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Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N.Y. —Sales Offices in Principal Cities, Distributors Everywhere

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

Stephen, Detroit, Mich.; William E., Columbus, Ohio, and Kevin, Cincinnati, Ohio.

Robert Grosvenor Ely (1904–1954), vice-president, The Connecticut Light & Power Co., Berlin, Conn., died Feb. 20, 1954. Born, Schenectady, N. Y., May 17, 1904. Education, one year, Union College; ME, Cornell University, 1926. Mem. ASME, 1944. Author of many papers.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting this information is printed on this page. Please use it to keep the master file up to date.

ASME Master-File Information

(Not for use of student members)

Please print **Check mailing address**

Name ..... (Last, First, Middle)

Home address ..... ☐ (Street, City, Zone, State)

Name of employer .....

Address of employer ..... ☐ (Street, City, Zone, State)

Product or service of company .....

Title of position held .....

Nature of work done .....

I am a subscriber to (please check)

Publication	*Address changes effective when received prior to:*
☐ Mechanical Engineering	10th of preceding month
☐ Transactions of the ASME	20th of preceding month
☐ *Journal of Applied Mechanics*	20th of preceding month
☐ *Applied Mechanics Reviews*	1st of preceding month

Please register me in three Professional Divisions as checked:

☐ A—Aviation	☐ J—Metals Engineering	☐ S—Power
☐ B—Applied Mechanics	☐ K—Heat Transfer	☐ T—Textile
☐ C—Management	☐ L—Process Industries	☐ V—Gas Turbine Power
☐ D—Materials Handling	☐ M—Production Engineering	☐ W—Wood Industries
☐ E—Oil and Gas Power	☐ N—Machine Design	☐ Y—Rubber & Plastics
☐ F—Fuels	☐ P—Petroleum	☐ Z—Instruments and Regulators
☐ G—Safety	☐ R—Railroad	
☐ H—Hydraulics		

John Taylor Farmer (1874–1954), mechanical engineer, Montreal Engineering Co., Ltd., Montreal, Que., Can., was killed in an accident, Feb. 2, 1954. Born, Liverpool, England, Dec. 14, 1874. Parents, John H. and Euphemia (Taylor) Farmer. Education, Warbreck College, Aintree, England; BS, MS, Liverpool University, 1894; came to Canada October, 1895; BASc, McGill University, Montreal, 1896; MS, 1897. Married Nora Eliza Pentin, 1908; three sons and two daughters. Mem. ASME, 1940. Member, Engineering Institute of Canada; Professional Engineers of Quebec.

Gregor H. Heine (1883–1953?), whose death was recently reported to the Society, was mechanical engineer, power plant construction, Gibbs & Hill, Inc., Indianapolis, Ind. Born, Hamburg, Germany, July 24, 1883. Parents, Martin and Therese Heine. Education, BS(ME), Catholic University of America, 1916. Naturalized U. S. citizen, Erie, Pa., Nov. 18, 1907. Married Anna Edythe Boyer, 1925. Assoc-Mem. ASME, 1918; Mem. ASME, 1924. Served the Society as vice-chairman, Erie Section, 1930; hon. chairman, Catholic University of America, Student Branch, 1930-1931.

Emil Jantsch (1892–1954), mechanical engineer, Arthur G. McKee Co., Cleveland, Ohio, died Feb. 17, 1954. Born, Vienna, Austria, March 1, 1892. Education, Technical Institute of Vienna, 3 years of a four-year mechanical-engineering course. Mem. ASME, 1942. He served the Society as vice-chairman, Youngstown Section, 1947-1948; chairman, Power Division, Youngstown Section, 1948-1949. He held a patent on a fluid-cooled tube for sighting a furnace pyrometer.

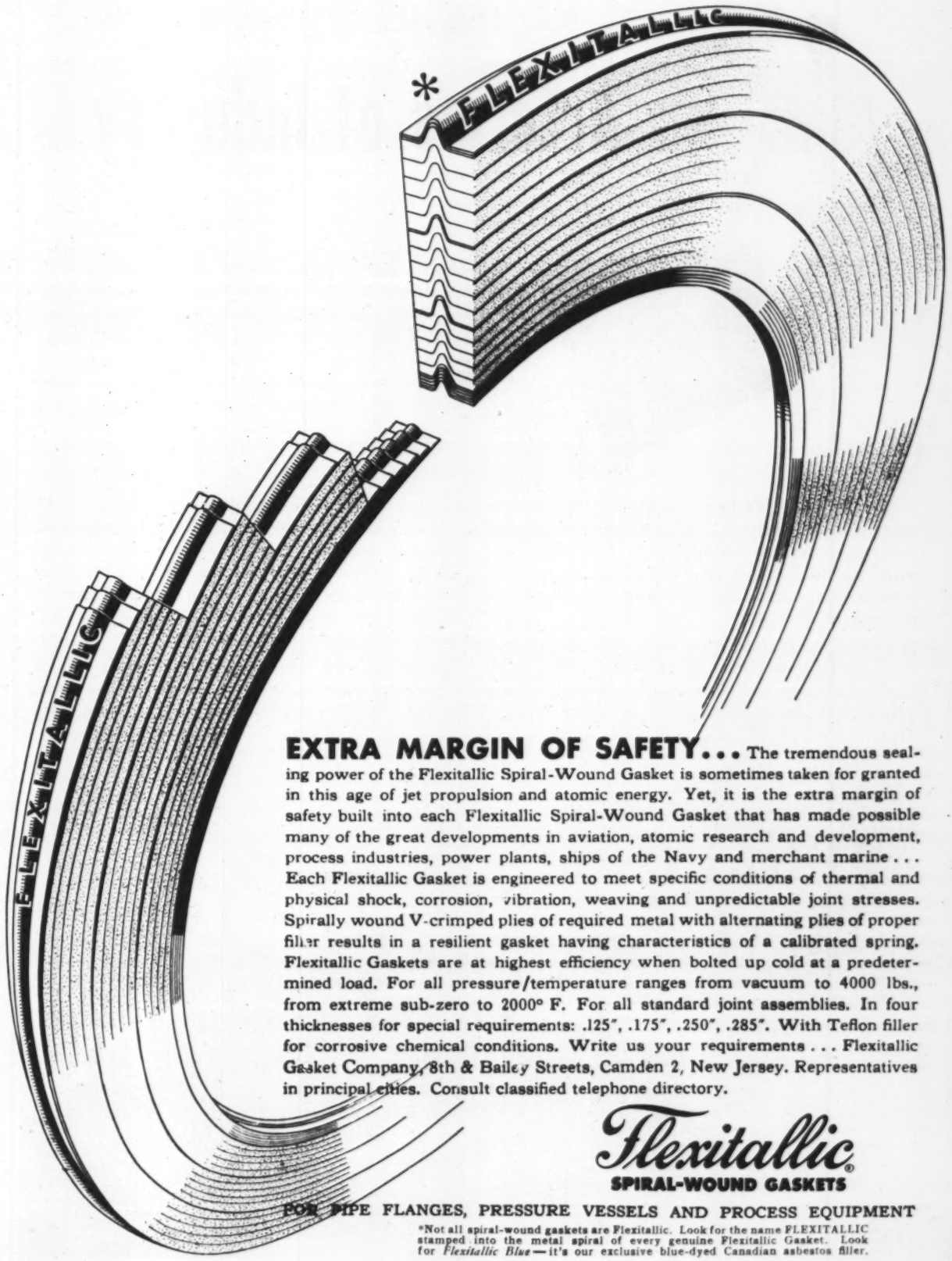
Harold Augustus Kemp (1894–1953), director, sanitary engineering, Government of the District of Columbia, Washington, D. C., died Feb. 16, 1953. Born, Frederick, Md., April 27, 1894. Parents, Robert A. and Daisy Alice (Birely) Kemp. Education, BS, Virginia Polytechnic Institute, 1917; special courses, Rutgers University, 1930. Married Helen Virginia Work, 1918; children, Helen W. (Mrs. Frank H. Whitney), Robert A., 2nd (deceased), Virginia B. (Mrs. W. H. Holcombe, Jr.). Jun. ASME, 1920; Mem. ASME, 1931. Prepared book, "Estimating Data for Bridges and Miscellaneous Engineering Structures", for U. S. War Department; author of "Solving Pollution Problems in the Potomac River Basin;" "Stream Pollution in the Washington Metropolitan Area;" "Soils Pollution in the Potomac River Basin."

Walter Lewis Leach (1900–1954), partner in the consulting firm of Havens and Emerson, New York, N. Y., died March 5, 1954. Born, Medina, Ohio, March 24, 1900. Parents, Frank H. and Mary (Sipher) Leach. Education, attended Ohio State University. Married Rhoda J. Nelson, 1926. Mem. ASME, 1942. Survived by wife; two daughters, Mary Rhoda and Mrs. Robert McCurdy; a brother, Arthur; and a sister, Mrs. Harold Morehouse.

Frank A. Lockwood (1876–1951), retired design engineer of Denver, Colo., died July 6, 1951, according to a notice received recently by the Society. Born, Stamford, Conn., Nov. 29, 1876. Education, Eidgenossishes Polytechnicum, Zurich, Switzerland; ME, Cornell University, 1901. Mem. ASME, 1921. Survived by wife, Jessie M. Lockwood.

Lester F. Nenninger (1894–1954), assistant manager, Machine-Tool Division, and vice-president of the sales subsidiary, Cincinnati Milling and Grinding Machines, Inc., died March 16, 1954. Born, Cincinnati, Ohio, May 4, 1894. Parents, Fred W. and Emanuella Nenninger. Education, Ohio Mechanics Institue; special courses, Cincinnati University. Married Minerva McGregor, 1920. Jun. ASME, 1920; Assoc-Mem. ASME, 1925; Mem. ASME, 1931; Fellow ASME, 1947. Held more than 80 U. S. patents for improvements on machine tools; author of several articles on machine tools, development and use of welded steel frames. He was a director of Ohio Mechanics Institute. Survived by wife; two daughters, Mrs. Allan Fosdick, Mrs. William J. Keating; a son, Thomas L.; a sister, Mrs. Marcella Reenan; and five grandchildren.

Elmer Torok (1884–1953), president, East Tennessee Sheet Metal Works, Inc., Bristol, Tenn., died Dec. 12, 1953. Born, Budapest, Hungary, Feb. 5, 1884. Parents, Paul and Mary Torok. Education, ME, Royal Hungarian Technical University, 1905. Naturalized U. S. citizen, New York, N. Y., December, 1913. Married Julia (?), 1911; daughter, Ella. Mem. ASME, 1936. He was author of "Handbook of Radio," 1924. In 1934 his book, "Psychrometric Notes and Tables," was published; "Air Conditioning," 1936; and "Air Conditioning in the Home," 1937.



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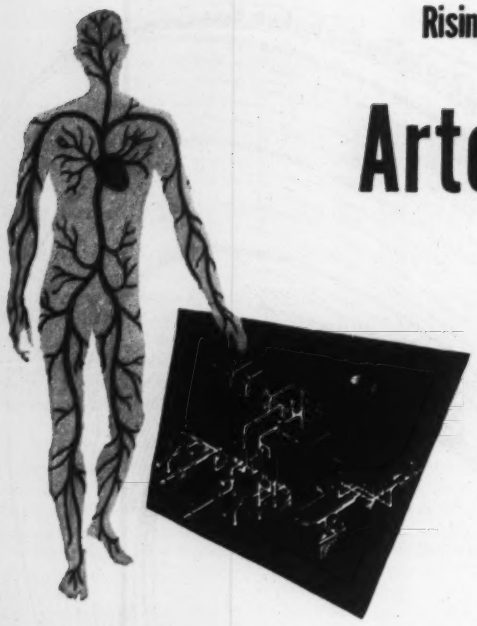
Rising pressure is a sign of robust health in the

Arteries of Industry



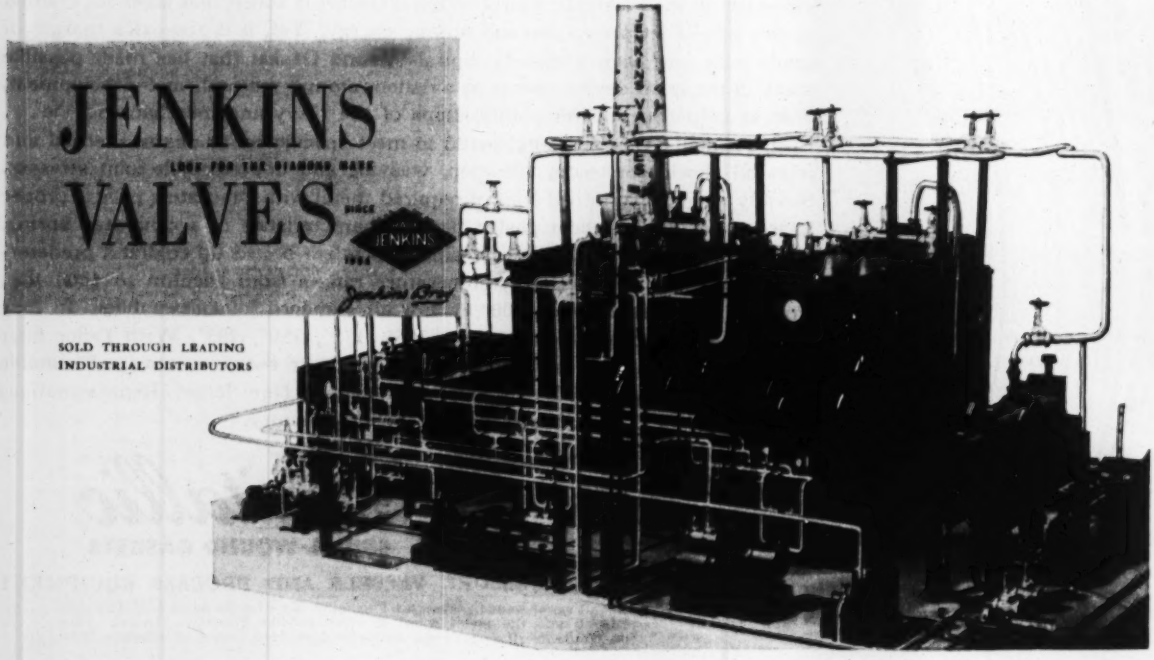
The vast piping networks threading modern industrial structures are comparable to the circulatory system of the human body. But in these "arteries of industry," a rapid pulse and higher pressures denote progress, not decline. Every development in processing technology, every rise in productivity brings a parallel advance in piping systems engineered for the task. They keep pace, in complexity and capacity, with mounting loads.

Valves to control the coursing fluids in these industrial arteries must be chosen with due regard for new-day demands. The penalty for valve trouble, in lost production and high maintenance, increases directly with complexity of modern installations.

If piping systems could be seen, as in the Jenkins Scale Model Power Plant illustrated, or in the "wall-less" structures now increasing in petro-chemical plants, their importance would be better realized. Since they are usually concealed, their major influence on successful operation is often overlooked.

The choice of Jenkins Valves for so many of the most efficiently operated plants in every industry is significant. The men who plan and erect the buildings that "make news" of industrial progress specify Jenkins Valves on their record of delivering an *extra measure* of efficiency and endurance.

Despite this extra value, *you pay no more* for Jenkins Valves. For new installations, for all replacements, let the Jenkins Diamond be your guide to lasting valve economy. Jenkins Bros., 100 Park Ave., New York 17.



KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING

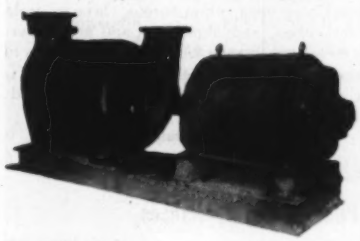
NEW EQUIPMENT

Hand Flaring Tool

The Parker Appliance Co. has added "Visi-flare," a new hand flaring tool, to its line of tube-fabricating equipment.

The tool is designed for formation of JIC and SAE hydraulic standard 37-deg flares on copper, aluminum alloy, fully annealed steel, and stainless steel tubing. The six tool sizes now available will accommodate tube ODs of 1/2 in., 5/8 in., 3/4 in., 7/8 in., 1 in., and 1 1/4 in. The tools ranged in weight from 0.23 to one lb.

Further data on the Visi-Flare Model 2865A may be obtained from Tube & Hose Fittings Div., The Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio.

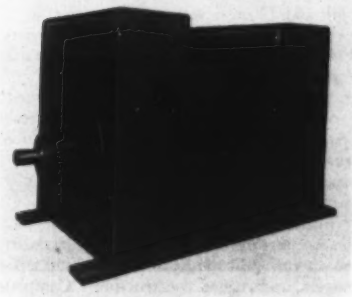


Centrifugal Blower

U. S. Hoffman Machinery Corp., Air Appliance Div., 105 Fourth Ave., New York, N. Y., has announced the development of a large volume standard production centrifugal blower with extreme adaptability. The company states that, using a combination of three interchangeable impellers, the No. 386 frame unit can be factory-assembled to deliver any air volume between 2000 and 9600 cfm, with pressures ranging from 1 to 9 psig, or vacuum from 2 to 12 in. Hg.

Units of the 386 series can be assembled from stock parts and tailormade to customer's needs in a matter of weeks instead of months, the company claims. According to Hoffman, the unit sells for about 30–50 per cent of the price of conventional custom models and can be delivered in a quarter to half the time.

The 386 series is of the same basic design as the conventional Hoffman blower.



Motor for Boiler Feed Service

A redesigned two-pole, 60-cycle, 3600-rpm squirrel-cage motor in ratings of 900 hp and larger incorporating features particularly applicable to boiler feed service has been announced by Allis-Chalmers Mfg. Co., Milwaukee 1, Wis. The redesigned motor features a new ventilation system, an improved oil seal, top air intake and discharge, and increased protection for the bearing, the company states.

Redesign of air passages and changing fans on the rotor from an axial-flow propeller type to a centrifugal type are said to have reduced noise level. Interior core ventilation was redesigned to incorporate spiral ventilation. Air inlet and air outlet on the redesigned motor have been shifted to the top of the machine.

Capsule bearing design was revamped, and the bearing housing was cored to provide atmospheric pressure relief.

Anti-Seize Thread Compound

A high-temperature thread compound that protects against the welding action of threaded connections subjected to prolonged exposure to extreme heat has been developed by Crane Packing Co., Chicago, Ill., according to a company announcement. Known as "Thred-Gard," it is said to eliminate seizing and galling at operating temperatures up to 1200 F.

The compound is non-hardening and acts as a lubricant to allow easy disassembly of threaded connections, even after lengthy service under the most severe conditions, the company states.

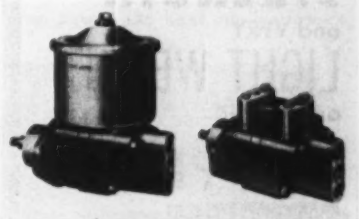
Thred-Gard is available in three cans: 1/2 pint, 1 pint, and 1 quart. Further information and prices can be obtained from Crane Packing Co., Dept. MXN, 1800 Cuyler Ave., Chicago 13, Ill.

Servo Motor with Tachometer Generator

Small, lightweight motor generators for use in servo controls have been announced by G-M Laboratories, Inc. The generator is housed in the same case with the servo motor.

Weighing approximately 4 oz, the dual unit measures 63/64 in. in diameter and 2 3/32 in. long. Both stators are embedded in an insulating compound.

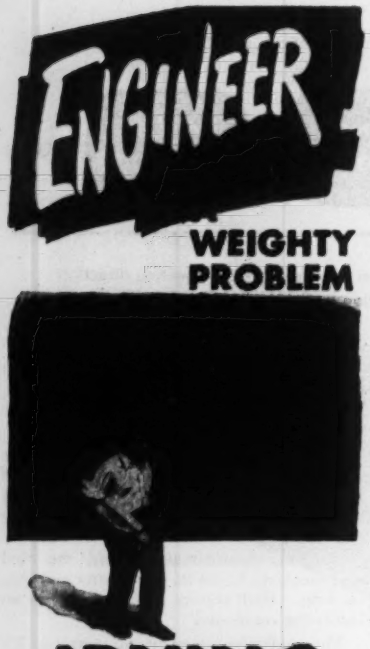
The maximum moment of inertia is 2.9 gm-cm^2. The motor is a two-phase unit with an input of 26 v per phase at 400 cycles, power input is 3.75 w per phase, stall torque is 0.35 oz-in. and has a no-load speed of 6500 rpm. The generator provides an output of 0.32 v per 1000 rpm. Maximum null voltage at 0.023 v. Units for other frequencies and voltages are available. Inquiries should be directed to G-M Laboratories, Inc., 4300 N. Knox Ave., Chicago 41, Ill.



Hydraulic-Steering Pumps

Vickers Inc. has announced general production of two pump series for hydraulic steering systems. Series VT16 consists of a Vickers vane-type hydraulic pump, flow control and overload relief valves, and integral oil reservoir. Series VT17 comprises identical pump and valve units without the reservoir and is designed for installations where a separate tank is preferred. The Series VT16 power package is designed for use with a hydraulic steering booster to form a complete power steering system.

Features claimed for the Series VT16 pump include long life, no load starting, and automatic maintenance of optimum running clearances for continued high efficiency. Series VT16 and VT17 power packages are available in three factory-set flow control capacities, 1 1/2, 2 1/2 and 3 gpm. Further information on these units is contained in Bulletin M-5104A. Inquiries should be addressed to Vickers Inc., 1500 Oakman Blvd., Detroit 32. Mich.



Multiple-Unit Reset Counter

Since its introduction a short time ago, the Veeder-Root Vary-Tally Counter has been used for quality control, inventory control, traffic control, sales analysis, laboratory analysis, payroll preparation, and other uses in a variety of industries, businesses, and institutions, according to the manufacturer, Veeder-Root, Inc.

The multiple-unit reset counter is available in any of 66 combinations, up to six banks high and 12 units wide, with a minimum of two units wide, arranged on stands in tiers. Fingertip pressure on the front lever of a unit registers each count from one to 9999. A reset knob returns all counters in any tier to zero with one complete turn of the reset shaft. The name, color, denomination, quality, size, etc., of the item to be counted is inserted in a panel over the reading line on each Vary-Tally.

Features are said to include no-glare, easy readability, even from an angle, portability, no obscuring of the figures by the operator's fingers, and rugged construction. Complete details and literature may be obtained from Veeder-Root, Inc., Hartford 2, Conn.

High-Tensile-Strength Bolts

The Standard Pressed Steel Co., Jenkintown, Pa., has announced that it is now producing precision bolts with a rated tensile strength of 200,000-225,000 psi. These aircraft bolts are the strongest steel fasteners of their kind ever to be made on a production basis, according to SPS.

The manufacturer has calculated that a single $1^1/_8$-in.-diam bolt in the new series could support the entire gross weight of the Air Force's B-47 Stratojet bomber, a load of more than 90 tons. The new high-tensile bolts are primarily designed for airframe assemblies.

SPS's 200,000-225,000-psi aircraft bolts come in 12 sizes ranging from $^1/_4$ in. to $1^1/_2$ in. diam. They are forged from 8740, 4340, and 4140 high-alloy steels. Bolts up to $1^1/_4$ in. are cold forged; larger sizes are hot upset forged.

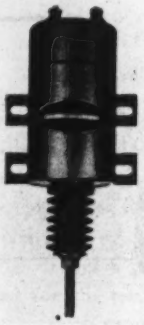
Pressure Controller

Black, Sivalls & Bryson, Inc., 7500 E. 12th St., Kansas City 3, Mo., has introduced the Type 1440 Pressure Controller (non-recording) for sensitive pressure-vacuum control systems.

Designed to handle both positive and negative pressures, from high vacuum to pressures up to 10,000 psi, the Type 1440 is a bourdon tube actuated with calibrated settings, including vernier setting for fine adjustment.

Proportional band and "on-off" or maximum-minimum snap action adjustment is made without additional parts, the company says, adding that either action may be adjusted to pressures up to 75 per cent of the limits of the bourdon tube rating. The Type 1440 is 8 × 4 in. in size, with door hinges to left or right and straight line piping.

Solenoids



Synchro-Start Products, Inc., Skokie, Ill., has announced the introduction of a continuous duty solenoid to their line of standard automatic and semi-automatic engine controls.

Model SD was developed to meet heavy-duty requirements. Enclosed in a sealed case to protect it from infiltration of dust and liquids, the unit claims an exceptional amount of power over a long stroke.

SD Solenoids can be furnished in standard and special voltages up to 115 v direct current. Pull is 10 lb over $1^1/_2$-in. stroke. Power consumption is 550 w pulling and 8 w holding. Housing dimensions are $4^3/_8 \times 2^1/_2$ in.

SD Solenoids are available with standard terminal screws or with the standard aircraft type AN connector.

Slide Rule for Milling Speeds

A slide rule giving speeds and feeds at a glance for milling operations is offered by Clarkson, Inc., manufacturer of Autolock and Dedlock Chucks and Milling Cutters. Readings are given for tough steel, medium steel, cast iron, phosphorous, bronze, mild steel, brass, and aluminum, and are conservative for Clarkson Cutters. Under tests in the Clarkson experimental department, it is claimed that much faster speeds and feeds have been attained.

The Clarkson Operator's Slide Rule is available from Clarkson, Inc., 320 Ontario St., Toledo 2, Ohio.

Pilot for Gas Appliances

A new pilot has been introduced by Robertshaw-Fulton Controls Co. for use in gas-operated appliances, the company has announced.

The new device is called the "target pilot," and was developed to overcome the susceptibility of ordinary pilots to linting and clogging at the primary air intake. According to the company, the new pilot does away with such air intakes and will maintain the steady blue flame needed for proper safety control operation.

Further information on the target pilot No. 2B may be obtained from the Grayson Controls Div., Lynwood, Cal., and the Robertshaw Thermostat Div., Youngwood, Pa.

Continued on Page 46

WHY 2 OF DENVER'S 5 REFINERIES SELECTED NICHOLSON STEAM TRAPS

may be important to you

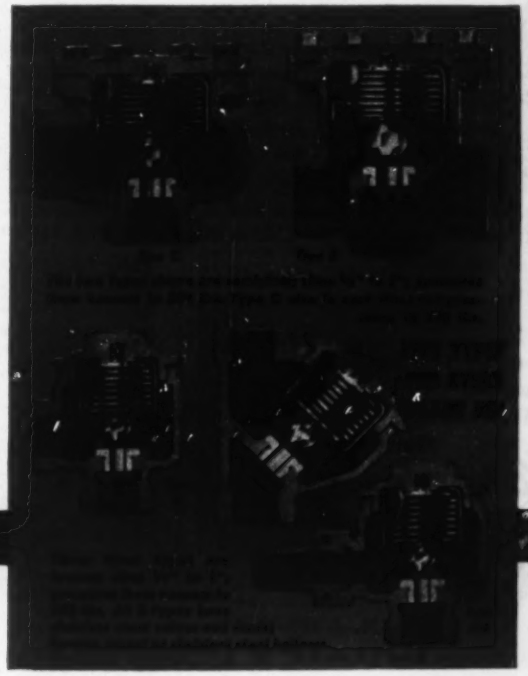
LIKE many industrial plants, the two operations referred to above had been using a considerable number of different kinds of steam traps. Both refineries have standardized on Nicholson traps, for practically all applications, for these basic reasons: Nicholson traps were found to be the most effective in improving heat transfer and in promoting production efficiency. These are advantages which, we believe, are of interest and importance to plant men in every industry.

A recent survey showed these Nicholson features to be reasons why an increasing number of leading plants are standardizing on Nicholson thermostatic traps:

1) Two to six times average drainage capacity; shorten heat-up time.
2) Operate at lower temperature differential; fast action keeps equipment full of live steam; higher and more even temperatures.
3) No air binding; eliminate costly fluctuation of operating temperatures.
4) Freeze-proof; drain completely when cold; can be freely installed outdoors.
5) Only one moving part; minimum maintenance.
6) No need to change valves for varying operating pressures from vacuum to maximum allowable.
7) Record low for steam waste; as little as 1%.

Types for every process, power and heat application.

Send for
CATALOG 953
Contains installation diagrams and data for determining proper size of trap.



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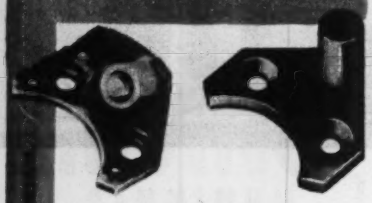

The part at left was composed of a machined stamping, two screw machine parts and a hardened steel bushing. The constant twisting and breakage of this fabricated part resulted in almost daily stoppage of the conveying system on which it was used.

By contrast, the part on the right, cast in *one piece* without further machining by EPCO Investment Casting, actually cost less and increased production. By making this important part from an air hardening tool steel, further heat treating was unnecessary, and a hardness of Rockwell "C" 53 to 55 was attained.

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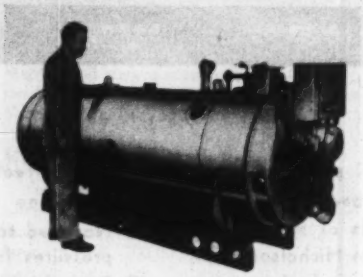
KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Fin Design for Heat Transfer

A new Delta-Flo fin design which improves the efficiency of extended heat transfer surface has been announced by The Trane Co., La Crosse, Wis., manufacturing engineers of air conditioning, heating, ventilating, and heat transfer equipment. The new fin will be used on Trane heating and cooling coils.

The fins have a delta-shaped ridge formed near the leading edge of the fin surface, and in front of each row of tubes in multi-row coils. This delta ridge is said to increase air turbulence over the entire fin surface.

Delta-Flow fins are mechanically bonded to coil tubes in a solderless joint that is claimed to be as strong as the metal itself and to provide maximum heat transfer efficiency. Details are contained in Bulletin DS-385, available on request.



Packaged Boiler

A packaged boiler called the CB has been announced by the Cleaver-Brooks Co., Milwaukee, for use in commercial, industrial, and institutional structures. The self-contained boiler, for processing or heating, steam or hot water use, is available in units of 15-to 40-hp capacity.

This new model, now available in sizes of from 15 to 40 hp, will be available in 50- to 80-hp sizes within a short time, according to the company. Further information on this new model will be supplied by the Cleaver-Brooks Co., 326 E. Keefe Ave., Milwaukee, Wis.

Tank Thermostat Valve

A tank thermostat valve, the No. 1449, has been announced by Klipfel Valves, Inc., for temperature control on small storage tanks, kettles, plating tanks, bottle and can washers, driers, industrial washing machines, ovens, vulcanizers, and similar equipment. The No. 1449 valve is tight-closing type.

The steam-actuating bellows is a one-piece metal design, liquid filled. Overstressing of the thermostatic system at over-range temperatures is prevented by an override spring, Klipfel states. Standard valves are provided in five 50-deg ranges from 25 to 275 F. Other ranges can be furnished. Each valve has a 50-deg adjustment range. The valve is made in sizes from $\frac{3}{8}$ in. to 1 in. Literature will be furnished on request to the manufacturer, Klipfel Valves, Inc., Hamilton, Ohio.

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Receiver-Integrator Unit for Graphic Panels

A receiver-integrator for graphic panels has been announced by The Foxboro Co., Foxboro, Mass., for use with the company's line of Consotrol instruments. A pneumatic-electric instrument, the new Type 224 Receiver-Integrator computes a continuous total of any process flow and operates a small counter located in the graphic display.

The integrator consists of two self-contained units: a remote counter and a flow receiver. The counter can be mounted on the front of a panel, usually in conjunction with a Consotrol strip-chart flow recorder. It totalizes to eight digits (or to six digits with zero reset wheel) and occupies $3^1/_4 \times 5^1/_2$ in. of panel space. The flow receiver unit composed of a receiver bellows and a cam-switch assembly, is housed in a metal box behind the panel. Two wires connect it to the counter.

In operation, pneumatic measurement signals (3–15 psi) from a flow transmitter at the process are received by the bellows which then positions the cam-switch mechanism. The cam-switch, in turn, produces an electric impulse to actuate the counter in relation to the flow measurement.

Integrators are available for uniform or square root scales to totalize minute, hourly, or daily rates. Service calibration checks can be made during operation with no extra equipment required, according to the manufacturer. Developed chiefly for graphic-type panels, the Type 224 Receiver-Integrator is said to be equally suited to control-cabinet installations.

Air and Gas Dehydrator

The Model CM-1 Dehydrafilter, recently developed by Hankison Corp., Pittsburgh, is a small desiccant air and gas dehydrator designed especially for isolated pneumatic equipment. Rated at 1 scfm at 100 psig and 70 F, the Dehydrafilter features a disposable desiccant cartridge and O-ring seal construction said to eliminate the need of tools to change the cartridge.

The Dehydrafilter consists of a head and case in which the desiccant cartridge is inserted. Compressed air from the supply source enters the unit, flows downward around the outside of the cartridge and upward through the desiccant bed. The dry air leaves the unit after passing through a visual saturation indicator. Right- or left-hand units are available for various installations. The Dehydrafilter will provide dew points as low as −67 F, the company reports.

Materials used in construction of the Dehydrafilter are brass for the head and case, and plastic-coated aluminum for the cartridge. The unit is designed for straight-through installation.

Further information on Dehydrafilters, is obtainable from Hankison Corp., 216 Biltmore Bldg., 951 Banskville Rd., Pittsburgh 16, Pa.

Roth Rubber Solves
Rubber Problem
for West Coast
Manufacturer!
A viewing hood for an oscilloscope seems like a simple problem for the rubber technologist, yet it is significant that Tektronix Inc., of Portland, had Roth Rubber, in Chicago, provide the solution. The viewing hood must not crack or buckle, has to adjust to any face and must exactly fit the Tektronix scope. Roth engineers solved this problem—they can solve yours.
Engineers and Rubber Buyers!
Write for your free Roth Rubber Sampler. This unusual kit contains actual rubber samples with hardness from 5 to 100 Durometer . . . gives ASTM specs and lists uses for each sample. Sorry, but offer must be limited to engineers and rubber buyers only. Please ask for Roth Rubber Sampler No. ME4.
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Please comment on attached description of our rubber problem or production rubber requirements.
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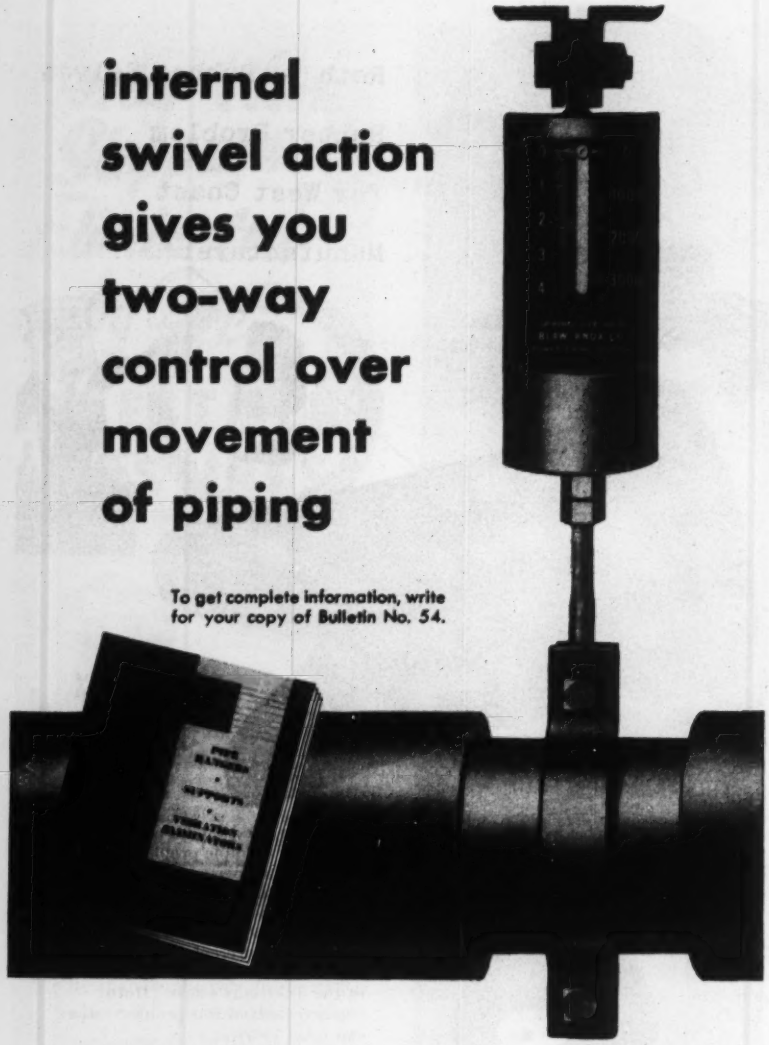
City Zone State

internal swivel action gives you two-way control over movement of piping



To get complete information, write for your copy of Bulletin No. 54.

You can readily control both the lateral and longitudinal swing movements of your piping up to 7° with our functional spring hanger.

For the hanger is designed with the Blaw-Knox patented *internal swivel action*, which permits movement while the hanger case itself remains vertical. Larger movements are readily accommodated by overhead roller assemblies. Each is a complete packaged unit ready to install.

In fact, our entire line of rigid hanger assemblies, overhead roller assemblies, vibration eliminators, as well as the functional hangers, are furnished as complete units . . . thereby saving you engineering time and eliminating expensive cutting, threading and assembling in the field.

Our engineers, who have had years of experience, are available to both design and make recommendations for your hanger requirements.

BLAW-KNOX COMPANY, Power Piping and Sprinkler Division, Pittsburgh 33, Pa.

BLAW-KNOX

PIPE HANGERS

Complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators . . . plus complete prefabricated power piping systems for all pressures and temperatures.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Recording Head for Magnetic Drum Systems

A recording head specifically designed for recording and reading binary data on magnetic-drum memory systems in digital computers has been announced by Librascope, Inc., 1607 Flower St., Glendale, Cal.

Consisting of a center-tapped toroidally wound coil, molded in moisture-proof epoxy resin, the read-record head features a new one-piece ferrite core. According to the manufacturer, elimination of the back-gap, reduction of the size of the front-gap to 0.0015 in., and use of a low-distributed-capacity winding results in less core reluctance, higher operating frequency, greater reliability and sensitivity of the read-back voltage, and improved temperature stability.

The resonant frequency of the read-record head is 500 kc. Crosstalk is said to be −60 db for adjacent heads. Gap and core face are perpendicular to the mounting surface within 0.0001 in. Each head is subjected to a 1200-v rms high-potential test, to insure high-voltage insulation. Effective operating temperature range is −20 C to 55 C.

Nylon Inserts for Plate Nuts

Nylon inserts are now available at no price premium in the line of anchor and gang channel nuts manufactured by Elastic Stop Nut Corp. of America, Union, N.J., according to a company announcement. These nuts, also called fixed nuts or plate nuts, are the types intended to become part of an air-frame or other structure. Formerly the standard insert material for Elastic Stop nuts of this type was fiber, with nylon inserts available at extra cost.

Elastic Stop nuts with nylon inserts have been qualified under AN366 by the Aeronautical Standards Groups, the company reports.

Engine Support Mountings

Lord Mfg. Co. has announced a new Center Bonded Mounting, J-5327-2, for isolating engine vibration from the vehicle body. This mounting is designed primarily for use on automotive engines and is of 200–300 lb normal load capacity. At assembly, the rubber is compressed when the mounting is installed in the bracket. Permanent seating of the mounting in the socket provides for rebound loads of over 500 lb.

According to the manufacturer, this new Center Bonded Mounting, which has been tested under actual service operations for over two years, provides performance at a lower cost, equal to, or better than full bonded mountings. In addition to the mounting being less expensive, the company declares, it is possible to eliminate the machining of the mounting bracket.

Other sizes of larger capacities are presently being designed and laboratory-tested. Additional information, will be provided by Lord Mfg. Co., 1635 W. 12th St., Erie, Pa.

Continued on Page 50

The shape of rings to come

It is difficult to predict the shape tomorrow's air power will take. But one thing is certain — fabrication of many of the component parts, such as rings, bands, and the complicated assemblies will be accomplished by welding.

If a new alloy — a special metal — an intricate assembly pose a problem to design or manufacture perhaps our specialized knowledge gained in 35 years of welding fabrication can help to find a practical and economical solution. Our Product Development Division will be glad to put experience gained from working with every major U. S. jet engine manufacturer to work for you. In addition to fusion and resistance welding of ferrous and non-ferrous metals, American Welding can provide designing, engineering, metallurgical and machining facilities.

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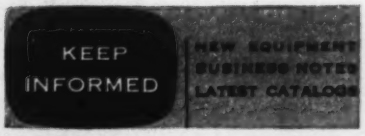
Division of United Aircraft Corporation
East Hartford 8, Connecticut

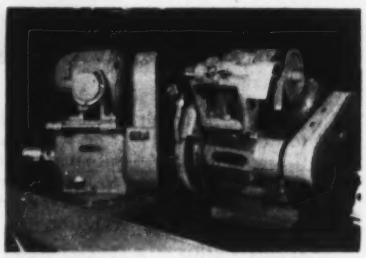


Palletless Handling Attachment

Industrial trucks equipped with a new clamping device designed for palletless handling of wooden cases and similar loads has been announced by The Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.

This attachment consists of a standard hydraulic clamp to which have been added a pair of heavy forks. The forks permit clamping of various containers and in addition are also designed for handling of palletized loads in the conventional manner. However, the thickness necessary to provide sufficient strength requires that pallets with a fairly wide opening be used, the company says.

The clamp arms or forks are equipped with pointed studs on their inner surfaces to insure a positive grip on the load. The front stud on each fork is positioned to permit inverting or dumping a container. The clamp has an opening ranging from 18 in. minimum to 66 in. maximum. It is controlled by a plunger-type hydraulic valve. The forks illustrated are 3 × 3 × 40 in.



Universal Grinding Machine

Norton Co., Worcester, Mass., has announced a universal grinding machine, the 12-in. Type U-4. The new machine has been designed to provide extra versatility through simplified set-ups and fast, precise grinding action for limited production items.

The principle new feature, the company says, is the swiveling headstock which has a dog drive plate on one end for conventional grinding and a 5-in. D-1 cam lock nose on the other end for mounting chucks or fixtures. To change from a dog-drive set-up to a chucking operation, it is only necessary to rotate the headstock 180 deg and set up the work, according to the manufacturer, who

adds that when work is being ground on dead centers, the chuck does not rotate because the headstock is a combination live- and dead-center type.

A work speed range of 40 to 400 rpm in an infinite number of increments is available. No direct-current source is required as the headstock drive is from alternating current controlled through rectifiers.

The Type U-4 machine has a $1^1/_4$-in. diam hole running through the headstock spindle to provide additional capacity for long shafts. The grinding wheel head itself has two swivel mountings, one for the wheel head itself to regulate the angle of the wheel with relation to the work, and the other swivel below the wheel feed mechanism to regulate the angle at which the wheel is fed into the work. Both these swivel mountings are graduated from 0 to 90 deg each side of the zero position. The adjustments can be made independent of one another.

Ball Bearing Pillow Blocks

Ball bearing pillow blocks with pressed steel housings, designed for applications where speeds are relatively low and loads are light, have been announced by Link-Belt Co. The new bearing blocks are said to cost less yet give all the advantages of precision anti-friction bearing performance.

The ball bearing pillow blocks, Link-Belt Series JPS-200, are available for shafts from $^5/_8$ to $1^1/_4$ in. in diam. They are installed by slipping the inner ring onto a shaft and locking it into position. Slotted bolt holes permit lateral adjustment. A synthetic rubber lip-type seal, integral with the bearing, provides sealing.

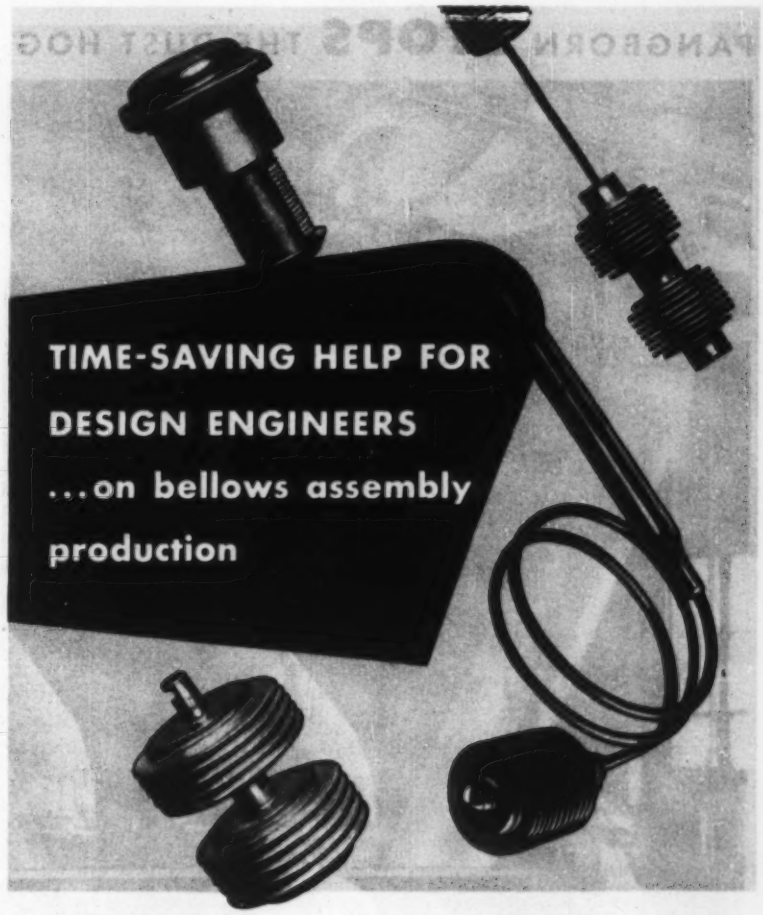
Additional information concerning the series JPS-200 bearings is available in Link-Belt Folder No. 2517, which includes load ratings and dimensions of pillow blocks.

Centrifugal Pump

Eco Engineering Co., 12 New York Ave., Newark 1, N.J., is offering a small centrifugal pump made of carpenter 20 stainless steel for handling a variety of corrosive chemicals or for noncontaminating service in food, biological, and similar applications.

Maximum capacity is 30 gpm. It will pump against a head up to 24 psi and has a maximum suction lift of 20 in. vacuum.

Further information is available from the manufacturer.



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PANGBORN'S 50TH ANNIVERSARY • 1904-1954

Burners

The Hauck Mfg. Co. has announced a line of series No. 620-P Vari-Pressure Low-Pressure Air-Type Burners for either oil or combination oil and gas. They are intended for multiple-burner furnaces, ovens, kilns, etc., where a group of burners are to be operated from one point to control the air and fuel by means of varying the pressures.

Single valve control of air-oil ratio and capacity is obtained with a control valve in the combustion air line serving a group of burners. The varying air pressure is then cross-connected to an air-oil ratio regulator for integrated varying of pressures.

Catalog No. 413, giving further details, may be obtained by writing to Hauck Mfg. Co., 124-136 Tenth St., Brooklyn 15, N. Y.

Roof Bolting Bit

A new cemented carbide-tipped prong-type roof bolting bit for drilling starter holes in ore, coal, and chemical mines has been developed by Carboloy Dept. of General Electric Co., Detroit, Mich.

Designated the APT-24, the drill bit was designed for hole-cutting in shale and strata softer than sandstone. It also can be used to cut $1^1/_2$-in. expansion anchor holes. The new tool has a standard $^1/_2$-in. square shank, of heat-treated alloy steel.

Roller Chain Sprockets

Morse Taper-Lock roller-chain sprockets in both single- and double-hub types are now available in an expanded line of stock sizes for No. 120 ($1^1/_2$-in. pitch), No. 140 ($1^3/_4$-in. pitch) and No. 160 (2-in. pitch) chain from Morse Chain Co., 7601 Central Ave., Detroit 10, Mich.

The No. 120 Type B (single hub) Taper-Lock sprockets are stocked in nine sizes from 13 to 26 teeth with a maximum horsepower rating of 75 hp. Number 120 Type C (double hub) driven Taper-Lock sprockets are stocked in five sizes from 35 to 80 teeth.

The Number 140 Type B sprockets are stocked in ten sizes from 12 to 26 teeth with a maximum rating of 95 hp. Number 140 Type C driven sprockets are stocked in four sizes from 35 to 70 teeth.

Morse No. 160 Type B sprockets are available in eleven stock sizes from 11 to 26 teeth with a maximum rating of 125 hp. The No. 160 Type C driven sprockets are made in three stock sizes from 35 to 60 teeth.

All stock Morse Taper-Lock sprockets in the new sizes up to 26 teeth are approximately 0.40 carbon steel and can be flame hardened to customer order.

Only five bushing sizes are required to fit the newly expanded line, the company says. They are being stocked by Morse distributors in 54 bore sizes fitting shafts from $1^5/_{16}$ to $3^1/_2$-in. diam in the No. 120 sizes, from $1^5/_{16}$ to 4-in. diam in the No. 140 sizes, and from $1^5/_{16}$ to $4^1/_2$-in. diam in the No. 160 sizes.

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NEW EQUIPMENT
BUSINESS NOTES
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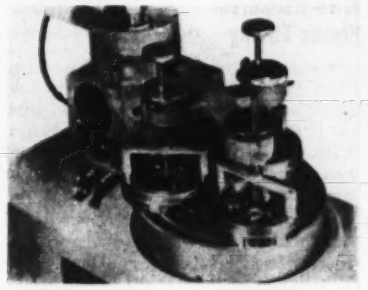


Lapping Shoulder Faces of Shafts

Crane Packing Co., manufacturers of the Lapmaster Lapping Machine, has announced development of a method for lapping shoulder faces of shafts.

The method consists of providing the lap plate with a series of annular grooves to accommodate the stem of the workpiece and allowing the shoulders to "ride" the top of the lap plate during the cycle. The fuel pump parts are pre-loaded into a special brass cylindrical work holder which has been bored out slightly over-size to the diameter of the workpiece. These special work holders provide the weight and balancing properties.

The adjustable roller guides located at the base of the conditioning ring guide stems are so located to the perimeter of the work holder that the parts being lapped will be held in proper position. Ball bearing races are used in the guides. The work is free to rotate in its own orbit on the lap plate.

The conditioning rings are spring loaded. Amount of spring tension is controlled by the set screw as shown in the foreground of the conditioning ring assembly at the left in the illustration. An indexing measure is provided on the spider bar arm cap.

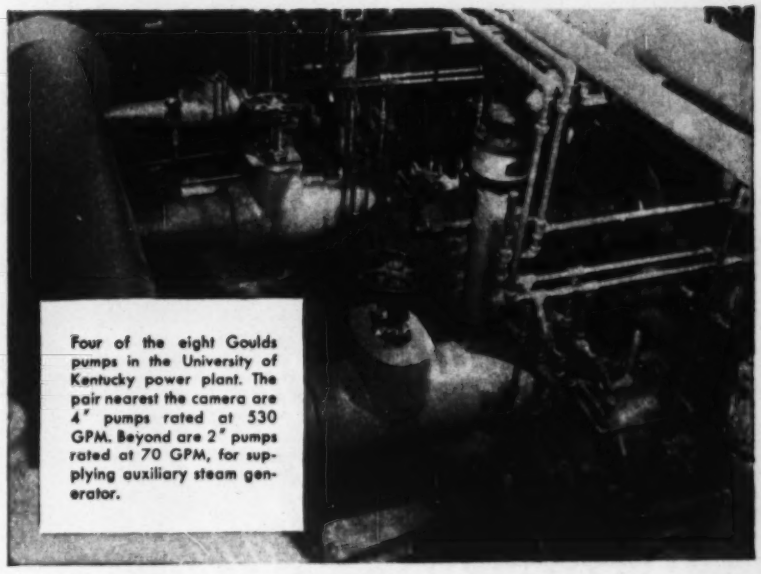
Additional information may be obtained from Crane Packing Co., Dept. MXN, 1800 Cuyler Ave., Chicago 13, Ill.

Vibrating Conveyor

A vibrating conveyor claiming greater simplicity, reduced power requirements and improved efficiency has been announced by Hewitt-Robins, Inc., Stamford, Conn.

The unit, mounted on springs, is designed to convey at a speed of 38 ft per min such materials as grain, bundled newspapers, metal scrap, chemicals, coal, sand and gravel, wood chips, beans, and flue dust. Pans with special coating or of stainless steel are available to make it suitable for handling extremely corrosive and abrasive materials.

Standard pans are 4 in. deep and can be supplied in widths of 8, 12, or 18 in. with or without top covers. The single-drive, 1-hp model is available in lengths ranging from 20 ft to 100 ft, and transfer sections can be used to couple two or more units in tandem. Extension sections, complete with springs and hardware, come packaged in corrugated cardboard cartons.



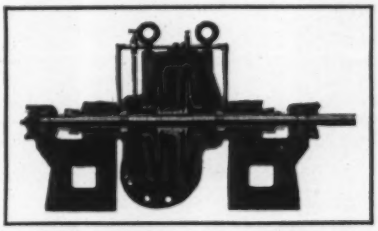
Four of the eight Goulds pumps in the University of Kentucky power plant. The pair nearest the camera are 4" pumps rated at 530 GPM. Beyond are 2" pumps rated at 70 GPM, for supplying auxiliary steam generator.

Boiler feed pumps TEACH STEAM PLANT ECONOMY

Doubling enrollment at the University of Kentucky meant increasing the load on the University's steam plant by 120,000 lbs. of steam per hour.

Failure of the steam plant would leave some 8,000 students and faculty without heat—and seriously cripple crucial scientific investigations. Obviously, reliability of equipment is essential. Flexibility, too—for economical operation during off-peak seasons. And, as space was limited, compactness was important.

Eight Goulds pumps for the new steam plant extension helped the University solve those problems. Four are 2-stage Fig. 3390 boiler feed pumps, supplying water to the steam generators at a head of 550 ft. The other four are condensate return and circulating pumps. All are compactly designed for minimum space requirements, and are precision-built for trouble-free operation and long service life.



Cross-section of Goulds Fig. 3390 centrifugal pump, showing opposed impellers, water-cooled stuffing box, and other construction features which make it a thoroughly efficient pump. Available capacities up to 1000 GPM. Heads to 900 ft.

Goulds pumps are available for every power plant application. Bulletin 722.3 gives detailed information and specifications of the popular Fig. 3390 boiler feed pump. We'll be glad to send you a copy or consult with you on any liquid-handling problem.

MEMBER

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Tube Sockets that

-withstand punishing shock and vibration

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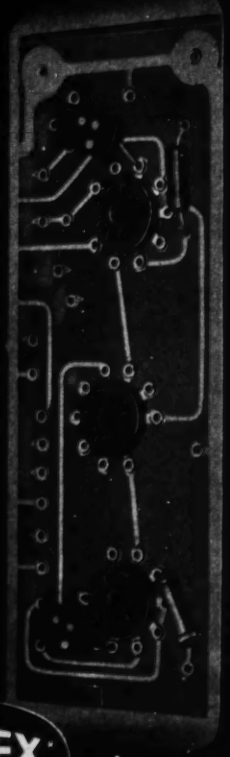

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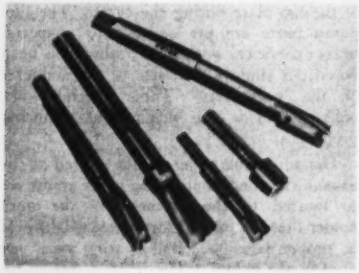
Wire-Reinforced Plastic Tubing

Newage International, Inc., has introduced Armourvin, a translucent plastic tubing with a "moulded-in" helical steel wire. The 120-ton tensile-strength wire is imbedded in the wall of Armourvin piping and is kept from contact with any of the liquids or gases either inside or outside of the piping.

The company claims that Armourvin will bend around a $^{5}/_{16}$-in. diam spindle without reducing its internal bore, and that $^{1}/_{8}$-in.-thick section has been flexed to an angle of 90 deg over $1^{1}/_{2}$ million times without cracking or breaking. Armourvin is said to be chemically inert and in addition flexible in extreme temperatures.

Armourvin is available in $^{1}/_{8}$–$^{1}/_{2}$ in. ID and $^{3}/_{8}$–1 in. OD. Further information and prices will be supplied by Newage International, Inc., 235 East 42nd St., New York 17, N. Y.



Counterbores and Spot Facers

High-speed steel counterbores and spot facers with interchangeable pilots have been added to the regular line of metal cutting tools manufactured by the Union Twist Drill Co., according to a company announcement.

Four styles of standard counterbores and spot facers are being manufactured: long, and short, set in both straight and taper shank. Two additional styles are made especially for the aircraft industry: long set, and short set, with $^{1}/_{4}$-in. shanks, designed for use with portable equipment such as hand drills.

Detailed information will be supplied by the Union Twist Drill Co., Athol, Mass.

Rivet Seal

A method of sealing flush rivets and screws has been developed by the Franklin C. Wolfe Co., Culver City, Cal., that is said to eliminate the need for sealing pastes, speed assembly, and provide a seal against gases or fluids at high and low pressures.

Called the Riv-O-Seal, the sealing device uses the O-ring method of sealing. The rubber O ring is not deformed beyond its elastic limits, and a metal-to-metal contact is maintained.

Further details and information is available from Franklin C. Wolfe Co., 3644 Eastham Dr., Culver City, Cal.

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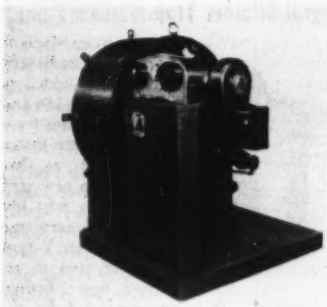

Packaged Combustion System

A packaged combustion system has been developed by Preferred Utilities Mfg. Corp., 1860 Broadway, New York 23, N. Y., to meet the heating and power needs of industrial and commercial plants capable of making oil-burner or oil-and-gas-burner installations on new or existing boilers with their own maintenance crews.

Called the Preferred Thermopak Plan, it includes a field-surveyed, individually engineered combustion unit with controls and accessories, factory-assembled and tested, ready for integration with the existing boiler and service connections.

The Thermopak unit, with controls and accessories, will convert any standard fire tube or water tube boiler (from 20 to 525 bhp maximum rating) to automatic oil-fired or combination oil- and gas-fired operation, using heavy fuel oil requiring preheating, according to the company.

The Thermopak plan includes a survey of the heating plant: steam requirements, boiler, setting and boiler room elevation, breeching and stack oil tank facilities, electrical specifications and location of outlets, etc. This survey, the company states, leads to a custom-designed Thermopak package to meet specific requirements, together with layout drawings and specifications.

Sealed Heavy-Duty Limit Switch

A new sealed heavy-duty precision limit switch, designed for use on industrial equipment where dust, dirt, abrasives, or liquids may be present, has been developed by Micro Switch of Freeport, Ill., a division of Minneapolis-Honeywell Regulator Co.

The switch is listed as 51MLI. The operating head is adjustable to any of four horizontal positions, and the roller may be reversed on the arm. The roller arm may be adjusted to operate clockwise, counter clockwise, or in both directions, and the actuator arm assembly is adjustable through 360 deg to any of 870 different positions.

The switch is listed by Underwriters' Laboratories for 20 amp 110, 220, or 440 v alternating current, 1/2 amp 115 v direct current; 1/4 amp 230 v direct current; 3/4 hp 110 v alternating current; 1 1/2 hp 220 v alternating current.

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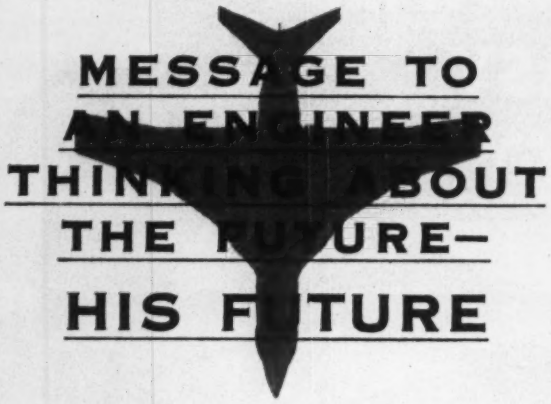

MESSAGE TO AN ENGINEER THINKING ABOUT THE FUTURE— HIS FUTURE

Take a few moments now to review the progress of your career. Does your present position offer you a future that fully utilizes your creative abilities?

Compare your present assignment with the diversified, stimulating pursuits that increase the inventive challenge of Fairchild's team of qualified engineers. These men are working on engineering advances for the famous C-119 Flying Boxcar and the soon-to-be-produced C-123 Assault Transport. More than that, they are developing tomorrow's jet fighters . . . special reconnaisance aircraft . . . jet bombers and transports. The men at Fairchild know that *planned* project diversification keeps them in the forefront of the field of aerodynamics.

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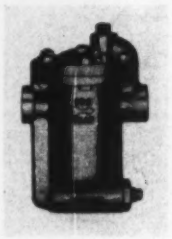
ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Aircraft Division
HAGERSTOWN, MARYLAND

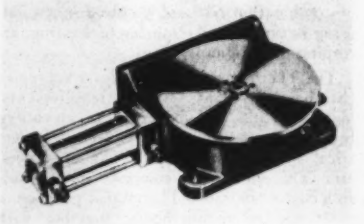
Integral Strainer Trap



Armstrong Machine Works, Three Rivers, Mich., has added to its line of integral strainer, steam traps a new larger model designated as No. 882. The new trap is said to cost less than a standard trap plus separate Y-type strainer, and to require fewer fittings to install it. It is recommended by the company for use where dirt and scale conditions are bad.

A stainless-steel strainer screen is located in the body casting at the bottom of the trap. The No. 882 has horizontal and opposite pipe connections of $\frac{1}{2}$-in. or $\frac{3}{4}$-in. size. Capacity ranges from 1300 to 2200 lb condensate per hr. Maximum operating pressure is 250 psig. Except for the built-in strainer, the trap is identical to the company's No. 812 side-inlet, side-outlet trap.

The body is fine-grained cast semi-steel. Internal parts are chrome steel and stainless. Overall trap height is $8\frac{11}{16}$ in., diam $5\frac{5}{8}$ in. Weight is 15 lb. List price is $25.50. The strainer bushing has straight threads and there is a copper asbestos gasket between the bushing and body.



Indexing Tables

The A. K. Allen Co., 57 Meserole Ave., Brooklyn 22, N.Y., has announced the manufacture of its new model 725-F Indexing Dial Feed Tables with the same positive lock feature as introduced on their larger models.

The tables have $7\frac{1}{4}$-in. diameter top plate and can be mounted either horizontally or vertically. Compressed air is available at the top center of the tables, so that air clamps, air collets, or air chucks can be operated from an outside source as the tables are revolving.

Model 725-FA is furnished without control valves and Model 725-FB comes equipped for fully automatic operation. Both models are available in the standard 4-6-8-12 and 24 set of indexing positions. Accuracy of indexing is guaranteed by the manufacturer within .002 at the periphery of the top plate. A descriptive bulletin is available on request.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Hand Tachometer

A portable, hand tachometer, featuring a scale-changing device which, it is claimed, reduces misreading of its various ranges, has been announced by the General Electric Co.'s Meter & Instrument Dept., Schenectady 5, N. Y.

Three different models, each having three ranges, are capable of measuring rotational speeds from 2 to 100,000 rpm and linear speeds from 2 to 10,000 fpm with accessories. Accuracy is plus or minus one per cent of full scale under all conditions, according to GE engineers.

Applications of the tachometer include speed measurement of motors, generators, turbines, lathes, milling machines, planer beds, shapers, band saws, conveyor belts, and all continuous webs.

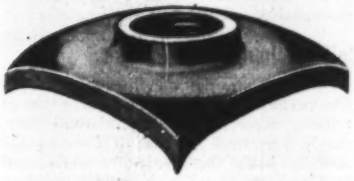
The equipment consists of two basic units: a head, which is placed against the moving object, and an indicator, which is attached by a 2-ft flexible electric cable.

The head unit includes a rotating shaft which operates a set of contacts through a positive cam mechanism. The head weighs 6 oz.

The indicating unit incorporates a reactance circuit, a multi-scaled milliameter, and a flashlight-cell power supply. Battery life is about two to three years, and changes in voltage may be compensated by a self-contained calibration circuit, the engineers said.

Accessories include two external cone tips, an internal cone tip, a 0.1-ft disk, a 1-ft disk, a low-speed adapter, a high-speed adapter, and an extension arm, all stored in a carrying case along with the tachometer.

The equipment has a total weight of $3^{3}/_{4}$ lb, including carrying case, which measures $11^{7}/_{16} \times 7^{5}/_{16} \times 3^{3}/_{4}$ in.



Self-Locking Nut

A self-gripping, self-locking nut which is said to eliminate the need for lock washers has been developed by the P-M Nut Div., of the Waterbury Pressed Metal Co., 300 Chase Ave., Waterbury, Conn. The P-M Nut is a concave fastener made of hardened and spring-tempered high-carbon steel. It has cut threads and a flange with turned-down corners.

Four sizes, 6-32, 8-32, 10-24, and 10-32, currently are available, and other sizes are planned. Free literature and samples are available on request.

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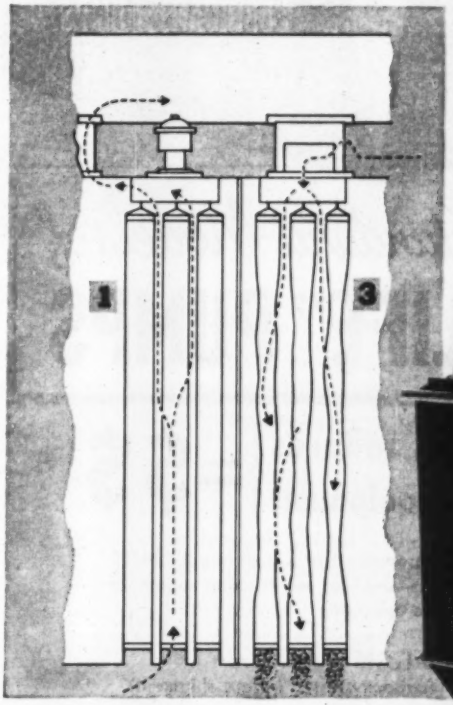
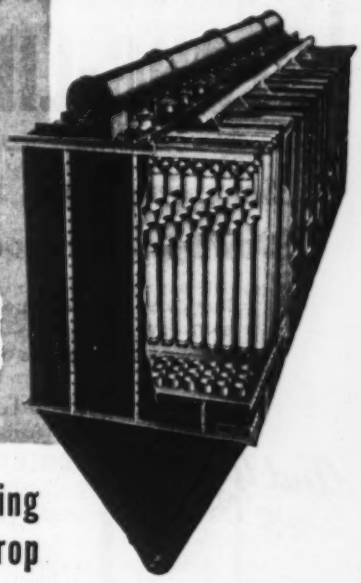
gives you 24 hour-a-day
DUST COLLECTION
at full rated capacity



Norblo Equipment is completely designed and fabricated in our own shops and sold on the basis of guaranteed performance.



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... Constant suction drop

Norblo Automatic Bag Type Dust Collectors have proved the soundness of these operating principles for over 25 years:

1. Basic unit compartment houses 78 cylindrical bags, fully distended by upward inside air flow.

2. Variable cleaning cycle timing, adjusted to dust load, insures constant volume of air handled and constant pressure drop across arrester.

3. Shaking and cleaning involves only one compartment at a time. During short vigorous reciprocating shaking period, reversed air flow insures cleaning of bags but in no way interrupts suction drop.

4. Any compartment may be cut out alone, for bag repair.

Write for Bulletin 164-3 giving full description.

The Northern Blower Company
Engineered Dust Collection Systems for All Industries
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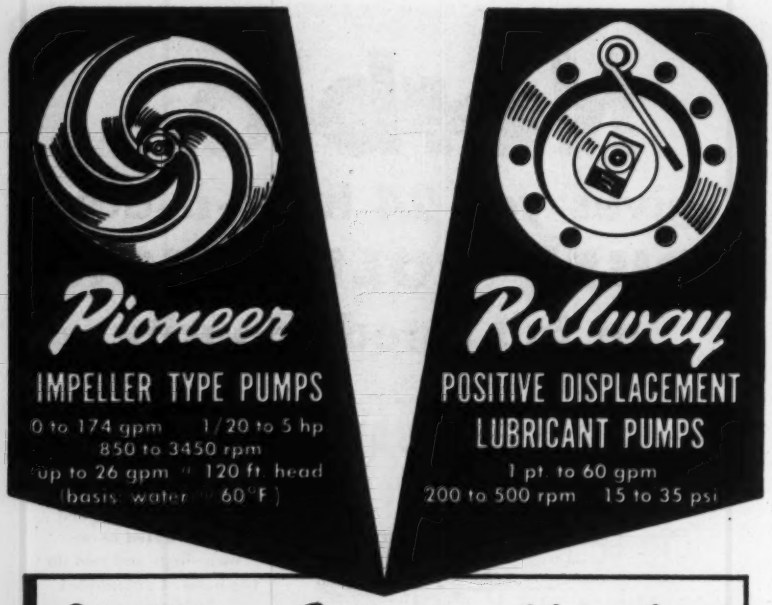
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IMPELLER TYPE PUMPS
0 to 174 gpm 1/20 to 5 hp
850 to 3450 rpm
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"LONG-LIFE" PUMPS

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Intake-Exhaust Silencers

Two series of silencers for quieting the noise produced by air compressors, blowers, vacuum pumps, and other machines expelling high-velocity air to atmosphere have been developed by Burgess-Manning engineers.

To be known as the Series CA and LCA, they are designed for operation under moisture-free air conditions and for temperatures up to 200 F. Both series are absorption-type silencers employing straight-through acoustically transparent perforated tubes surrounded by a layer of sound-absorbing material, and therefore, Burgess-Manning says, feature minimum restriction to air flow. Special sound-absorbing material can be used for operation at considerably higher temperatures than the standard of 200 F.

The CA Series is available in pipe sizes up to 6 in., whereas the LCA Series is available in sizes larger than 6 in.

Literature is available on both the Series CA and LCA and may be had by writing directly to Mr. H. A. Dietrich, Burgess-Manning Co., Libertyville, Ill.

Carbide-Tipped Circular Saw Blade

A line of planer-type carbide-tipped circular saw blades designed to perform a wider variety of cuts than is possible with conventional designs of carbide-tipped blades has been introduced by DeLuxe Saw & Tool Co., High Point, N. C., a subsidiary of Rockwell Mfg. Co.

Chief advantage of the new blades, the manufacturer claims, is their ability to perform both ripping and cross-cutting operations with equal ease and good finish on hand-feed operations. These blades also claim from 25 to 100 times longer life than regular blades. They can be used to cut such materials as plywood, plastics, micarta, masonite, and laminated products.

The blades are offered in 8-in., 10-in., 12-in., 14-in. and 16-in. sizes throughout the United States and Canada. Special sizes are available.

Coil Mechanism for Meters

The design of a new meter mechanism provides performance stability typical of that of a gyro, according to the manufacturer, Marion Electrical Instrument Co. In applications where the effects of vibration and rapid attitude changes must be considered, the operation of the mechanism is said to be particularly successful. Designed to develop maximum torque for a given volume of magnetic material, the mechanism employs an end-pivoted coil assembly with a one-piece bearing shaft and mechanical assembly that operates in a self-shielded magnet structure. This produces approximately 6000 Gauss in a single air gap.

The manufacturer says performance characteristics of the mechanism also suggest application as the sensitive element in control devices where it is required to initiate a control function. Further information is available from Marion Electrical Instrument Co., Manchester, N. H.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Welding-Head Oscillator

The Lincoln Electric Co., Cleveland, Ohio, has announced an automatic welding equipment for producing beads up to 4 in. wide in a single pass. The equipment, called Spreadarc, is an attachment that mounts on a standard Lincolnweld automatic head and oscillates the head back and forth at right angles to the direction of travel. The amount of oscillation can be controlled to produce a pad of weld metal up to 4 in. in width in a single pass. It may be used to build up a layer of hardsurfacing metal or to build up with mild steel, Lincoln says.

The Spreadarc may be installed on Lincolnweld heads now in use without any major changes required, the company states. It is powered by its own variable speed electric motor which through an eccentric oscillates the entire welding head assembly. The width of the oscillation is controlled by an adjustment of the eccentric and the number of oscillations per minute by a rheostat control of the motor speed. Speed and width are controlled to meet varying requirements. The Spreadarc may be turned off completely when normal straight welding beads are desired.

Fluxes normally used with Spreadarc for hardsurfacing are "agglomerated" alloy fluxes, according to the manufacturer. A mild steel or medium carbon wire is used, the alloys being added to the weld metal through the fluxes in the crater. Lincoln states that agglomerated fluxes create a uniform, dependable deposit and can be varied to create a deposit to match different service requirements.

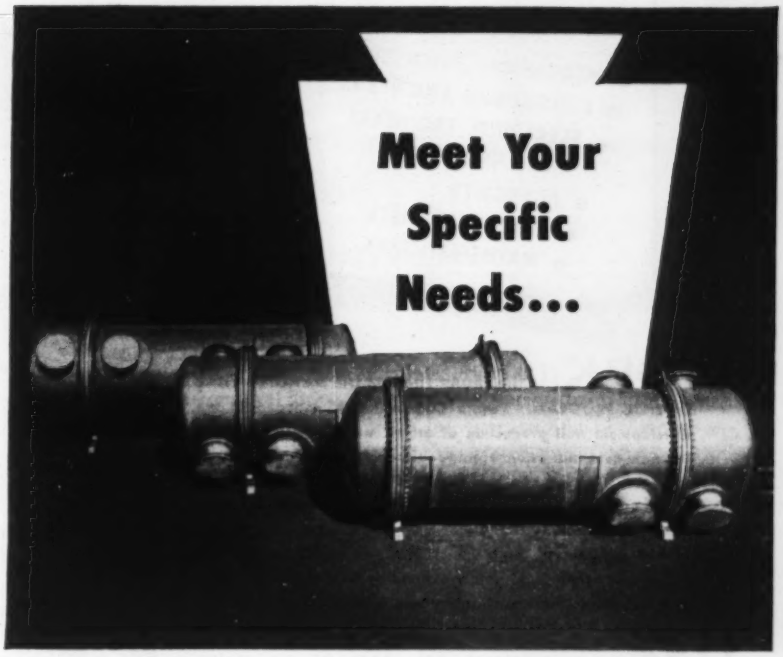
Ventilation Air Filter

The Roll-O-Matic, a product of the American Air Filter Co., Inc., Louisville 8, Ky., is an automatic self-cleaning air filter of glass fiber filtering media, designed for use in commercial and industrial ventilating and air conditioning systems to clean both outside and recirculated air.

The Roll-O-Matic filtering media is a continuous length of fiber glass material, similar to that used in AAF Amer-glas filters except that it is supplied in rolls of approximately 70 linear ft. The material from the roll of clean media, mounted at the top filter casing, is transported on a continuous screen that rotates over top and bottom sprockets, down the face of the filter and is rerolled at the bottom after collecting its dust load.

A pressure switch sensitive to the resistance differential across the filter curtain actuates a drive motor that rotates the screen and feeds a certain amount of clean media into the filter curtain when the resistance reaches a predetermined point.

The Roll-O-Matic is made in vertical sections 3 ft, 4 ft, and 5 ft wide and in heights from 5 ft to 15 ft in four-inch increments. One drive mechanism will operate from three to six sections depending upon their height, according to the company. Bulletin No. 248 will be issued free upon request.



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Heat transfer equipment designed and built by Downingtown Iron Works will do a specific heating or cooling job in your plant—and do it efficiently.

Downingtown engineers are thoroughly experienced in designing custom-built heat exchangers for all sorts of chemical and petroleum applications . . . have accumulated a wealth of heat transfer data which can help solve your specific problems.

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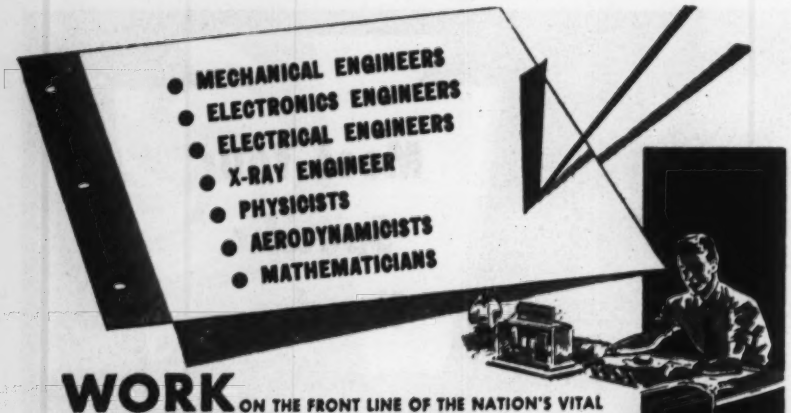

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ENJOY THESE OTHER IMPORTANT ADVANTAGES. These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates Sandia Laboratory under contract with the Atomic Energy Commission. Working conditions are excellent, and salaries are commensurate with qualifications. Liberal employee benefits include paid vacations, sickness benefits, group life insurance, and a contributory retirement plan. This is not a Civil Service appointment.

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DIVISION B

SANDIA *Corporation*

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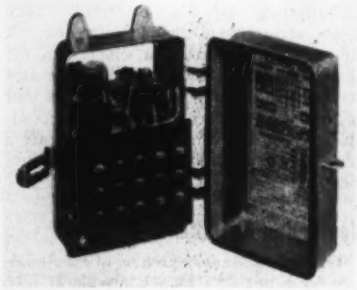
Totally Enclosed and Explosion-Proof Motors

U. S. Electrical Motors, Inc., has announced that maximum ratings available of U. S. horizontal totally enclosed and explosion-proof motors have been increased to 150 hp. The explosion-proof motors are supplied with the Underwriters' Laboratories label for Class I—Group D, and Class II—Groups F and G.

Both type motors are double-enclosed, with a built-in fan. Additional features include asbestos-protected windings, stator cover plate, solid, dynamically balanced, cast aluminum rotor, Lubriflush bearings, and normalized castings.

U. S. totally enclosed and explosion-proof motors are available from $^1/_8$ to 150 hp. They can be supplied in combination with U. S. Varidrives when variable speeds are desired, or on U. S. Syncrogears when geared multiplied torque is needed. Further information and a bulletin concerning these motors are available from U. S. Electrical Motors Inc., Box 2058, Terminal Annex, Los Angeles 54, Cal.



Liquid Level Control

Photoswitch Inc., 77 Broadway, Cambridge 42, Mass., has announced the introduction of Level Control Type 13DJ3, to control the level of all electrically conductive liquids. The control consists of an electron tube amplifier and relay combination which operates from minute currents in the probe circuit. There are no floats or stuffing boxes. Contact with the liquid is made only by corrosion-resistant stainless steel probe rods. Accuracy is claimed independent of temperature and pressure. A single control, through flexible terminal panel connections, provides for operation as either a pump-up or pump-down control, or a high or low level safeguard with fail-safe action for all five types of operation. The control is universal for either 115 or 230 v 50/60 cycle supply.

The resistivity range is from zero to 20 megohms per cc. Type 13DJ3 incorporates a heavy-duty relay which may be wired for double-break operation to carry up to 20 amp non-inductive at 230 v, alternating current, or to operate directly a $^1/_3$-hp motor. The control operates at a maximum probe voltage of 11.5 v for all resistivity ranges,

with a current range of 6 ma decreasing to less than 1 μa at maximum resistivity. The control may be located at distances up to 100 ft from the probe installation. Level Control Type 13DJ3 is furnished in a variety of housings to satisfy different requirements of location and mounting.

Bulletin PF-544 contains further information and is available on request.

Valves and Other Products

Klinger products are now manufactured in the United States, according to an announcement by the Klinger Corp.

The "Klingerflow" Seatless Piston Valves are claimed capable of withstanding the highest pressures and temperatures encountered in present-day practice. "Klingerflow" Valves retain their pressure tightness by the fit of a piston sliding through two resilient compressed valve rings. Other "Klingerflow" Valve advantages are said to include: extremely low maintenance, perfect control of flow, no seats or grinding, and being unaffected by wire drawing.

Other products available in the Klinger line are: "Klingerit", an asbestos sheet-packing available in thicknesses from .008 to 1/4 in.; and Klinger T-type water level gages, provided with Klinger Sleeve-Packed shut-off and drain cocks.

Further information on any of the Klinger products will be supplied by Dept. 4, The Klinger Corp. of America, 95 River St., Hoboken, N. J.

Sprockets

Extension of the "off-the-shelf" line of Taper-Lock sprockets to include the 1 1/2-in., 1 3/4-in., and 2-in. pitch sizes has been announced by Dodge Mfg. Corp., Mishawaka, Ind., manufacturer of power transmission machinery. Users of single-strand roller chain will now be able to secure sprockets and bushings for chain sizes from 40 through 160 direct from distributors' shelves ready for immediate installation without delay for reboring, keyseating, drilling, and tapping, Dodge says.

All Taper-Lock sprockets in the new larger pitches, up through the 26-tooth size, will be made of high carbon steel and can be hardened. Larger sprockets will be available in close-grained semi-steel. A new condensed supplement to the 16-page Taper-Lock bulletin is now available. This supplement contains up-to-date sizes, weights, dimensions, and list prices of the extended line of Taper-Lock sprockets and Dodge roller chain.

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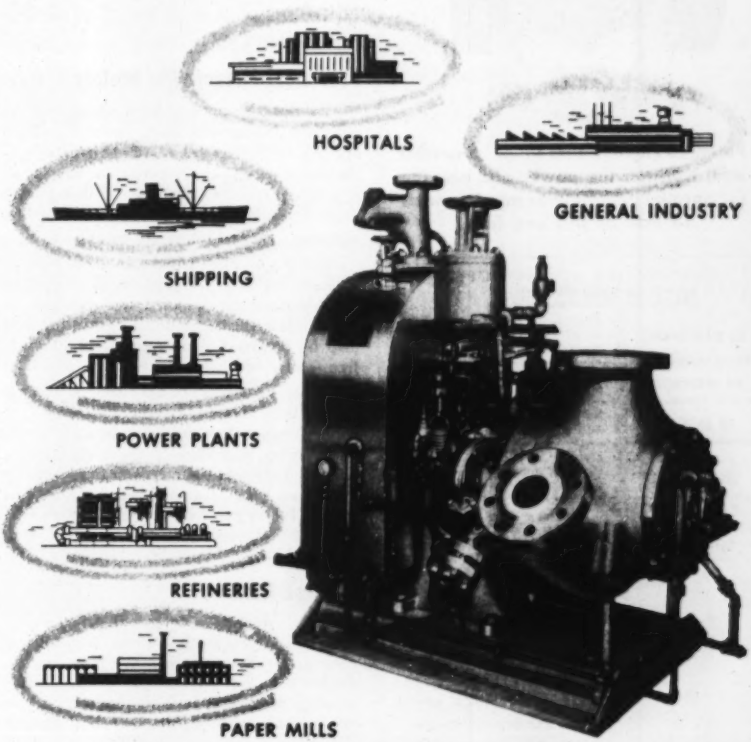
On board ship, in refineries, hospitals, public utilities—in paper, textile and all general industry, the Coffin line of turbo equipment is earning nation-wide acceptance for outstanding performance. Designed with versatility in mind, latest addition to the line the Coffin "DE" Turbo Pump has a Volumetric Range to 800 GPM, Discharge Pressures to 1500 psi, Steam Temperatures to 850° F., Exhaust Pressures to 80 psig, and Liquid Temperatures to 325° F. Ratings can be exceeded in special installations.

Engineers! Write today for complete specifications. Ask for "DE" Bulletin G-107.



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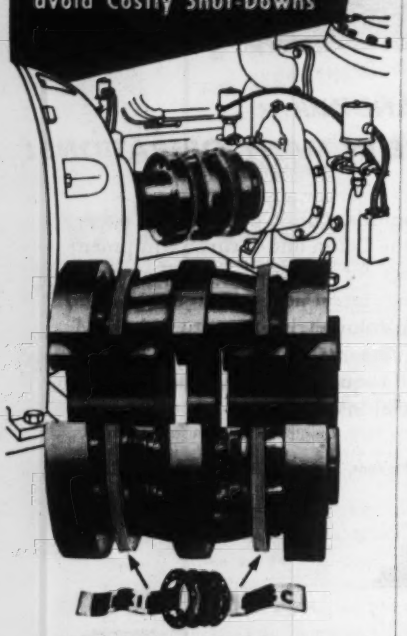
Specify THOMAS ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.

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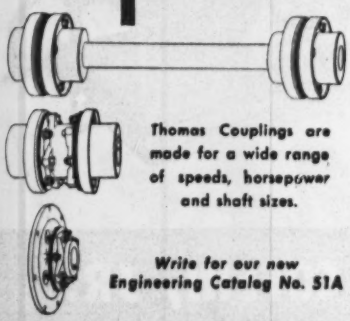
FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Thomas Couplings are made for a wide range of speeds, horsepower and shaft sizes.

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THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

KEEP INFORMED — NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Powdered-Metal and PlasticCompound

A putty-like material consisting of steel powders and plastic has been announced by the Chemical Development Corp., Danvers, Mass. Called Devcon, it can be used to make drill jigs, fixtures, forming dies, and similar products in a fraction of the time previously required and at a fraction of previous costs, according to the manufacturer.

Devcon is said to be as easy to use as modeling clay, requiring neither heat nor pressure. After the desired shape has been formed, Devcon becomes an extremely strong, tough, and rigid metallic piece in approximately two hours, the company says. It can be sawed, drilled, tapped, threaded, and ground with conventional metal-working equipment, Chemical Development Corp. states.

Devcon is supplied in 1-lb and 4-lb cans, and in bulk containers. The amount of hardener necessary is supplied with each standard container, together with a supply of a special release agent. A bulletin will be sent upon request.

Fractional-Horsepower Motors

The Borg-Motor has been announced by the Borg Equipment Div., Janesville, Wis., offered in either two- or four-pole synchronous or induction types, in ratings of 1/2000, 1/1500, 1/1000, or 1/750 hp, with power claimed dissipated within safe temperature rise. Borg-Motors are totally enclosed.

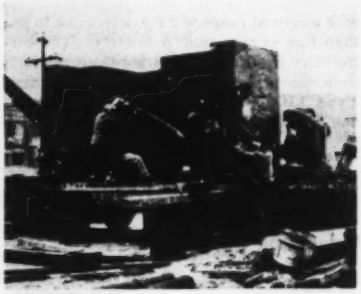
Any of the series can be supplied with or without an internal gear train. Standard Borg-Motors are designed for operation on 115-v, 60-cycle current. Borg-Motors may also be obtained with special voltages and frequencies.

Similar Borg-Motors have proved successful in Borg Time-O-Graph watch rate recorders and other precision equipment for many years, according to the manufacturer. These fractional horsepower motors are known as Borg-Motors Series 1001 through 1008. Inquiries for further information should be addressed to The George W. Borg Corp., 120 S. Main St., Janesville, Wis.

Rupture Disk

Black, Sivalls & Bryson, Inc., manufacturers of safety heads for the protection of pressure systems against overpressure, has announced the publication of a six-page bulletin on a new type of rupture disk for low-pressure and highly corrosive applications.

The disk is available in sizes 2 in. through 10 in. and in rupture pressures from 5 to 100 psig. Illustrated and printed in two colors, the bulletin gives information on construction, operation, pressure ranges, manufacturing tolerance, choice of materials, and information required for order processing. The free bulletin will be furnished upon request. Letters should be addressed to Black, Sivalls & Bryson, Inc., 7500 E. Twelfth St., Kansas City 26, Mo.



Anvil Base

Shown is an anvil base for one of two 50,000-lb drop forge hammers being installed at Kropp Forge Co., 5301 W. Roosevelt Rd., Chicago, Ill., as part of the company's five-million-dollar expansion program. The anvil base weighs 390,000 lb and took fifteen men and four trucks three days to unload.

The anvil is only one-third of the foundation required for a 50,000-lb drop forge hammer, said to be the largest of its kind in the world. The foundation, which is 42 ft wide, 36 ft long, and 23½ ft deep, will also include 5½ million lb of concrete with reinforcing steel. The entire installation, including the hammer and foundation, will weigh close to 8 million lb.

ENGINEERS

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Here's opportunity for *you* as a part of Fairchild's expanding operations in the field of propulsion — including turbines, reciprocating engines, new-type powerplants and propellants. Whether you're well experienced or just getting your start in this field, we would like to talk with you. Won't you write or visit us and outline your complete background. Replies are kept in complete confidence, of course.

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Y-Section for Conveyors

A power-driven Y unit said to eliminate clogging and "jam ups" on converging conveyor lines has been developed by Harry J. Ferguson Co., Jenkintown, Pa. The unit consists of a power driven 90-deg roller-conveyor curve and a 5-ft long, live straight-roller conveyor section, both of which are chain driven by a single 1/2-hp gearhead motor through universal joints.

Offering speeds up to 90 fpm, the Ferguson Power "Y" can be incorporated into all types of package conveyor lines, whether on the floor or suspended from the ceiling, according to the company announcement. A plastic guard is mounted on either side of the unit.

Complete details will be provided by Harry J. Ferguson Co., Jenkintown, Pa.

BUSINESS NOTES

Moves Western Regional Office

Keeping pace with the increasing demands of western industry for Consolidated Engineering Corp.'s broad line of analytical, measuring and recording instruments, CEC Instruments, Inc., sales and service subsidiary of the Pasadena instrument manufacturer, announces the opening of new and enlarged quarters for its Western Regional Office at 1025 E. Green St., Pasadena, Cal.

Clark Appoints Alberta, Canada, Dealer

Materials Handling Equipment Co. 10347 73rd Ave., Edmonton, Alberta, Canada, has been appointed to sell and service Clark Industrial fork-lift trucks and other materials handling equipment manufactured by the Clark Equipment Co., according to a company announcement.

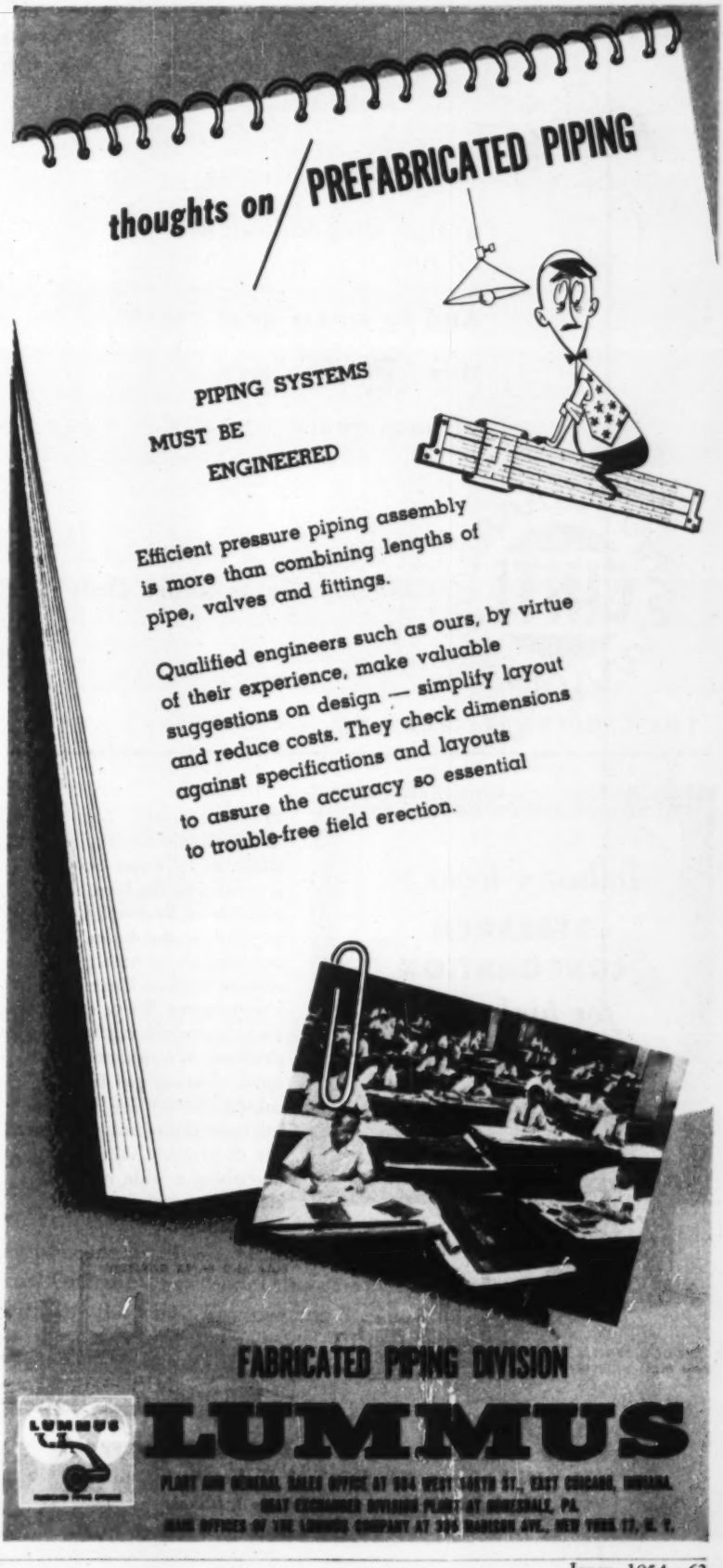
Included in the franchise is the sale and service of the straddle-type carriers formerly manufactured by the Ross Carrier Co., which was acquired by Clark last year.

Orr & Sembower Names Kentucky Representative

Orr & Sembower, Inc., Reading, Pa. has announced the appointment of Ogle Engineering Sales, Louisville, Ky., as sales and service representative handling Powermaster packaged automatic boilers in central and western Kentucky.

Frank J. Ogle, Jr., is in charge of activities. Offices are maintained at 3207 Preston Highway in Louisville. Mail address is Box 74, St. Matthews Branch, Louisville 7, Ky.

For Consulting Engineers Turn to Page 136


thoughts on PREFABRICATED PIPING
PIPING SYSTEMS MUST BE ENGINEERED
Efficient pressure piping assembly is more than combining lengths of pipe, valves and fittings.
Qualified engineers such as ours, by virtue of their experience, make valuable suggestions on design — simplify layout and reduce costs. They check dimensions against specifications and layouts to assure the accuracy so essential to trouble-free field erection.
FABRICATED PIPING DIVISION
LUMMUS

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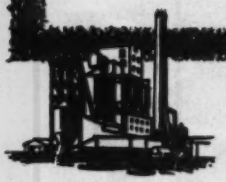
Industry looks to
RESEARCH CORPORATION
for high dust collection efficiencies



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To maintain visually clean stacks at all times, industry is turning to the long experience of Research Corporation in the design and manufacture of highly efficient Cottrell Electrical Precipitators. We've spent 40 years in solving such problems as nuisance abatement, cleaning gas for subsequent use and recovering materials of value. Write for illustrated bulletin describing a wide range of electrical precipitator applications.

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122 South Michigan Ave., Chicago 3, Illinois
Bound Brook, N. J. • *Grant Building, Pittsburgh 19, Pa.*

Chase Brass & Copper to Handle Stainless Steel

Stainless steel, in sheet, bar, wire, and tube, has been added to the warehouse stocks of Chase Brass & Copper Co., a subsidiary of Kennecott Copper Corp., according to an announcement by Chase. Chase will merchandise stainless steel from its 27 warehouses and sales offices across the country through an arrangement made with Crucible Steel Co. of America, Pittsburgh, Pa.

The announcement of the new line of stainless steel products also said that this move will have no effect on continued production of brass and copper products by Chase. The concern produces brass and other copper alloy products in sheet, rod, wire, pipe, and tube.

Timken To Build New Furnace

A new $278,000 continuous-annealing furnace will be erected at the Gambrinus plant of The Timken Roller Bearing Co., Canton, Ohio, to increase production of heavy-walled seamless tubing, the company has announced. Increased demand from the oil industry for heavy walled seamless tubing used in tool joints has made the new furnace necessary, according to the announcement.

Measuring 175 ft in length and 6 ft 8 in. in width, the new furnace will be housed in a building 300 × 24 ft. The furnace will have a capacity of 3000 tons of annealed seamless tubing per month, and will be gas fired, although capable of using fuel oil in emergency situations. Completion is expected the latter part of September, 1954.

Fischer & Porter Establishes Automation Division

By acquiring the patents and engineering personnel of the Electrical Development Co., Inc., and the Digi-Coder Corp., Fischer & Porter Co., Hatboro, Pa., is able to offer data reduction systems necessary in plant and production automation. Using a fully mechanical digital converter, called the Digi-Coder, as the first addition to its present line of measuring and recording instruments, the company says it is now able to engineer, produce, and install completely automatic control systems from the sensing element at the machine or process to the coded or tabulated digital data output. The two newly acquired corporations have been integrated into Fischer & Porter as the Data Reduction and Automation Div.

Robert K. Stern, formerly president of Electrical Development Co., Inc., is manager of the new division and has maintained his entire engineering staff. Fischer & Porter expects to follow the Digi-Coder with the development of other automation equipment such as remote data logs, temperature and pressure scanners, sequential data recorders, remote pressure and thermocouple readout systems, and voltage-to-digital converters.

Continued on Page 67

the complete line FOR ALL YOUR NEEDS

YOU CAN specify TUBE-TURN Welding Fittings and Flanges and know that you will get the *exact* answer to your specific piping problem. This leading line includes more than 4,000 items, in all piping materials . . . carbon steels, non-ferrous metals and alloys . . . schedules and sizes to match *your* design.

Carbon steel elbows, for example, are available from ½" to 42" diameter. Your nearby Tube Turns' Distributor provides this *complete* line promptly and backs it up with the thorough Engineering Service and how-to-do-it information of Tube Turns.

The Leading Manufacturer of Welding Fittings and Flanges

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Here's *Service* to help you solve your piping problems

TUBE TURNS' Engineering Service Division makes available a vast fund of experience for the solving of design and operating problems in piping. For example:

An engine builder was fabricating manifolds from formed plate. Poor fitup was a problem and costs were excessive. Tube Turns' engineers suggested using TUBE-TURN Welding Returns, cut with templates as shown in the sketch. Costs came down. The dimensional uniformity of TUBE-TURN Welding Returns and Elbows simplifies fabrication jobs such as this because they can be cut to odd angles and adapted to special requirements.

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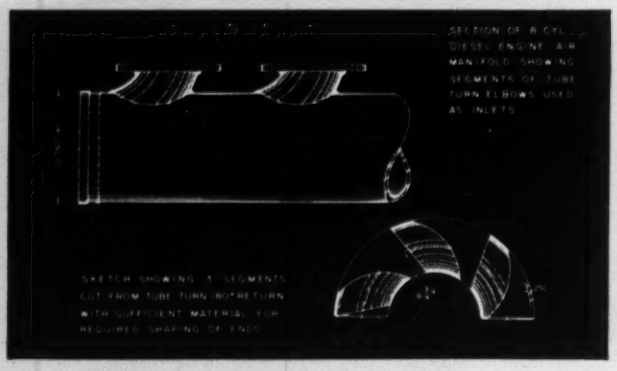
SECTION OF 8 CYL. DIESEL ENGINE AIR MANIFOLD SHOWING SEGMENTS OF TUBE TURN ELBOWS USED AS INLETS
SKETCH SHOWING 3 SEGMENTS CUT FROM TUBE TURN 180° RETURN WITH SUFFICIENT MATERIAL FOR REQUIRED SHAPING OF ENDS

Header connection design problem solved by Tube Turns' Engineering Service.

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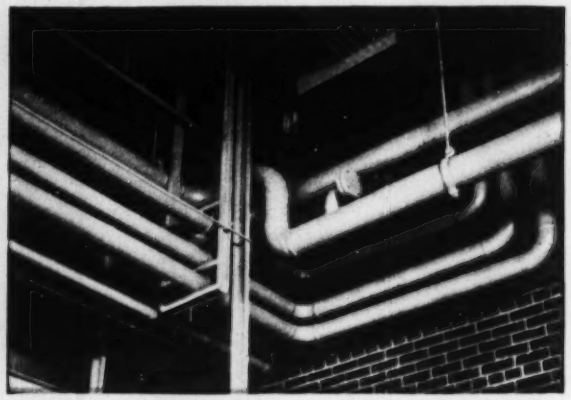
YOUR NEEDS in welding fittings and flanges are met *promptly* by your Tube Turns' Distributor. This one reliable source can fill *all* your requirements from the world's most complete line of welding fittings and flanges comprising more than 4,000 items.



MANY USES. Piping in this modern edible oil plant conveys natural gas, hydrogen, oil, steam, cooling water, refrigerants, air and vegetable oil. All critical lines are welded and TUBE-TURN Welding Fittings are used for directional changes. Pipe sizes vary from 2" to 16".

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Streamlining SAVES PRECIOUS FUEL

STREAMLINE the flow of gases across the boiler tubes and you get more steam from less fuel. That is what Enco Baffles do. They use scientifically curved baffle surfaces instead of sharp angles. They taper the passes to maintain velocity as the gases decrease in volume, which promotes heat-transfer. They:

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Adaptable to any type of water-tube boiler, fired with any fuel. Designed for each individual installation. Only selected materials used. Installed by skilled mechanics. Send for Bulletin BW 44.

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Enco
Streamline Baffles
Produced exclusively by The Engineer Co.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Fairbanks, Morse Sets Up Electronics Division

Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, has announced the organization of an Electronics Div. for the company. This division will be responsible for research, development, application engineering, and manufacture of electronic devices and apparatus used in conjunction with various Fairbanks-Morse products, principally scales.

L. J. Maguire, formerly general manager of the St. Johnsbury, Vt., Works of the corporation, has been appointed manager of the new division. His offices will be located in Davenport, Iowa, where the company has a scale research group in operation.

Robertshaw-Fulton Opens New Plant

Robertshaw-Fulton Controls Co. has expanded its production facilities with the opening of a new plant, with 70,000 sq ft of space, at Indiana, Pa., fifty miles northeast of Pittsburgh. The company has taken a five-year lease on the $475,000 plant, constructed for Robertshaw-Fulton by the Industrial Development Corp. of Indiana, for the manufacture of certain new products now being readied for the market, according to company president John A. Robertshaw.

The company manufactures controls for home appliances and industrial applications, automotive thermostats, electronic recorders, and controllers, and other devices. W. D. Miller, assistant vice president of Robertshaw-Fulton and general manager of the Robertshaw Thermostat Div. at Youngwood, Pa., will be in charge of the new plant at Indiana.

FOR A BRIGHTER TOMORROW GIVE TODAY

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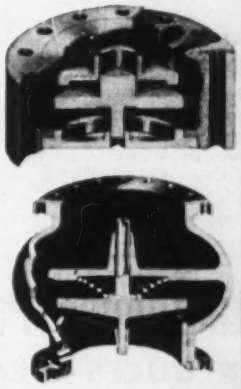
GIVE TO YOUR LOCAL AFFILIATE

For all Piping systems handling . . .



WATER
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and other fluids

WILLIAMS-HAGER FLANGED *Silent* CHECK VALVES

Send coupon today for your copy of Bulletin 654! This bulletin gives complete details on these dependable Williams-Hager check valves and how they eliminate water hammer and other costly and annoying noises in all types of piping systems. Available in sizes for every service. Renewable working parts. Write today.

THE WILLIAMS GAUGE CO., INC. 654 ME
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Please send me a copy of Bulletin 654 on Williams-Hager Flanged Silent Check Valves.

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3013 Pennsylvania Ave., Pittsburgh 33, Pa.

KEEP INFORMED — NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

United Conveyor Names Minn.-Wis. Representatives

Reed & King, Inc., Foshay Tower, Minneapolis 2, Minn., have been appointed exclusive representatives in Minnesota and a portion of northwestern Wisconsin for the United Conveyor Corp., Chicago, Ill., suppliers of pneumatic and hydraulic ash and fly-ash handling systems.

Worthington Announces Incorporation of New Japanese-American Company

The joint incorporation of a new Japanese-American company under the name Niigata Worthington Co. Ltd. was announced by S. Riley Williams, Vice President in charge of Foreign Business, Worthington Corp., Harrison, N. J.

Westinghouse Pneumatic Control

REDUCES WEAR AND TEAR ON PAPER MACHINE

THILMANY PULP AND PAPER COMPANY, Kaukauna, Wisconsin, selected Westinghouse Air Brake Co. Pneumatic Control to assure smooth, shock-free operation of a new paper machine. Westinghouse Valves are used to precisely adjust pneumatic clutches and brakes on the dryer rolls, couch, presses, calendar, and reel.

The great accuracy of Westinghouse Valves enables the operator to apply air pressure very gradually to prevent rapid, abrupt engagement of clutches, and to accurately regulate the amount of braking on any roll. As a result, he controls the big rolls on this machine smoothly and gently to prevent torn paper and undue wear on clutches.

Wherever you need precise control of linear motion—on brakes, clutches, small presses, positioning devices, sequencing mechanisms, and the like—investigate the possibilities of Westinghouse Pneumatic Control. Our engineers will be glad to help you. Just write, explaining your problem.

Westinghouse Air Brake COMPANY

INDUSTRIAL PRODUCTS DIVISION WILMERDING, PENNA.

Manufacturers of air compressors, pneumatic cylinders, actuators, air control devices of all kinds, engineered pneumatic control systems and front end loaders.

Factory Branch: Emeryville, Calif. Distributors throughout the United States...see your Classified Directory. Distributed in Canada by: Canadian Westinghouse Co., Ltd., Hamilton, Ontario.

Revere Buys Lockport, Ill., Plant

Revere Copper & Brass Inc. has purchased a plant in Lockport, Ill., for the production of Lockseam tube, rolled mouldings and shapes, presently made in the company's Chicago Mfg. Div.

The new plant contains 52,500 sq ft of space and is on an eight-acre site. The plant was previously owned by the Globe Corp., manufacturers of aircraft equipment. The Lockport plant will fabricate items in nearly all commercial metals, the company says, including steel, copper-plated steel, brass-plated steel, copper and copper-base alloys, aluminum, zinc, and stainless steel.

LATEST CATALOGS

Giant Cap Screws

A four-page illustrated folder on a new line of giant Unbrako cap screws of heat-treated alloy steel has been prepared by Standard Pressed Steel Co., Jenkintown, Pa.

Net prices are given for diameters of $1^1/_8$, $1^1/_4$, $1^3/_8$ and $1^1/_2$ in. in lengths up to 12 in. Prices on diameters of $1^3/_4$, 2, $2^1/_4$, $2^3/_4$, and 3 in. in lengths up to 12 in. can be had on application. Shipping weights on all sizes are listed. Prices will also be supplied on application for diameters over 3 in. and lengths over 12 in. up to 36 in.

The bulletin will be sent free by Standard Pressed Steel Co., Box No. 558, Jenkintown, Pa.

Steel Products

Tens of thousands of sizes, shapes, and grades of steel products are listed in the new 226-page Warehouse Stocklist and Reference Guide published by Jones & Laughlin Steel Corp., Pittsburgh 30, Pa.

The $8^1/_2 \times 11$-in. spiral-bound book lists the steel items stocked in J&L's nine warehouses. Commodity classifications include structurals; plates; sheet and strip; stainless; hot-rolled and cold-finished bars; forging steels; alloy and tool steels; bolts, rivets, nails, and rails; wire and wire rope. The Stock List has a general index at the front and individual indexes on each of the divider tabs for the commodity sections.

A separate section on Data includes such information as decimal equivalents, sheet gage weight, thickness and order limits, chemical compositions, typical heat treatments, and machinability ratings. There is also a section devoted to cutting extras.

The book is available from any Jones & Laughlin Steel Warehouse. Warehouses are located in Chicago, Cincinnati, Detroit, Louisville, Memphis, Nashville, New Orleans, New York, and Pittsburgh.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Precipitator

The Permutit Co. has announced the availability of Bulletin 2204B, 20 pages, covering applications, principles of operation, design features, advantages, recommendations, flow diagrams, and specifications of Permutit's Precipitator. Three basic designs are offered for the removal of impurities from a liquid by precipitation, adsorption, settling, and filtration. These units are said to require less space, less chemicals, and less reaction time than previous designs. They can be used to soften water, remove turbidity, color, taste, and odor, and reduce alkalinity, silica, and fluorides.

Copies may be obtained from The Permutit Co., 330 West 42nd St., New York 36, N.Y.

Steam Traps

The V. D. Anderson Co. has revised their 36-page catalog, "Solving Steam Trap Problems", to include information on their new combination float and thermostatic traps, claimed to vent air in one-eighth the time of standard inverted bucket traps.

The catalog contains specifications and capacities on steam traps, float traps, air release valves, and pipe line strainers. It tells how to calculate condensation loads and select traps for unit heaters, jacketed kettles, autoclaves, submerged surfaces, steam mains, header drips, and other equipment. Installation and servicing information is included. Copies are obtainable from the V. D. Anderson Co., 1935 W. 96th St., Cleveland 2, Ohio.

Quenching Units

A catalog entitled "Controlled Quenching" has been released by Bell & Gossett Co., Morton Grove, Ill. The catalog describes two of the company's small self-contained units, the Junior Quencher and the Perambulator Oil Cooler.

The Junior Quencher is a quench system designed for controlled quenching in laboratories, tool and die shops, and anywhere that small-piece custom heat-treating is done. The B&G Perambulator Oil Cooler is a portable combination oil cooler and quench tank. Of greater capacity than the Junior Quencher, it fills the need for a controlled quenching system which can be moved from place to place.

Catalogs are now available and can be had by writing directly to the factory.

Use a CLASSIFIED
ADVERTISEMENT
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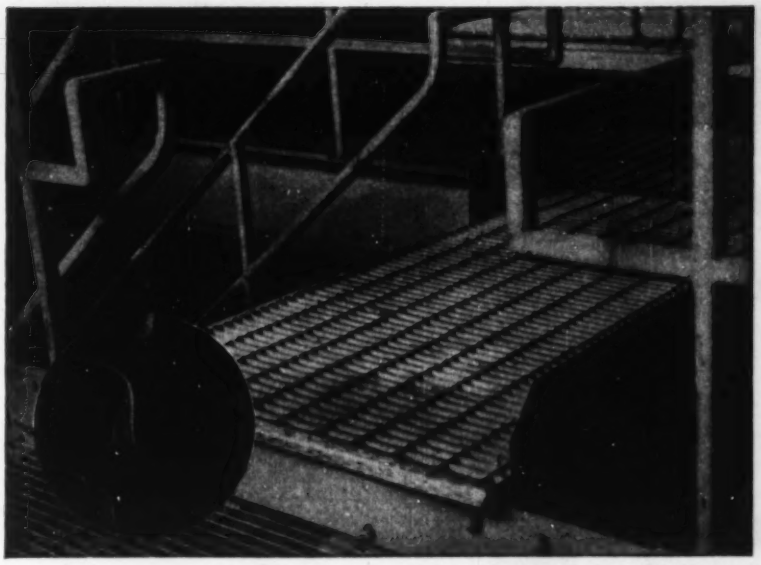


Grating by BLAW-KNOX

where do you need
steel grating?

There must be lots of places where you are now using grating—floors, platforms, walkways, catwalks and stair treads, for example.

But how about other uses—such as some sturdy shelving or a fan guard—or for covering a dangerous open pit or a light well. Take a good look around your plant and you'll probably come up with several jobs, including perhaps a new use, as steel grating is adaptable to many applications.

Any time you want some help on a job related to grating, we'll be glad to hear from you.

Only BLAW-KNOX Electroforged® Steel Grating and Stair Treads —have these five exclusive features:

1. rigid one-piece construction—easy to install
2. all surfaces accessible—easy to paint
3. no sharp corners to clog—self-cleaning
4. maximum open area—for light and ventilation
5. non-slip twisted crossbar—safe footing

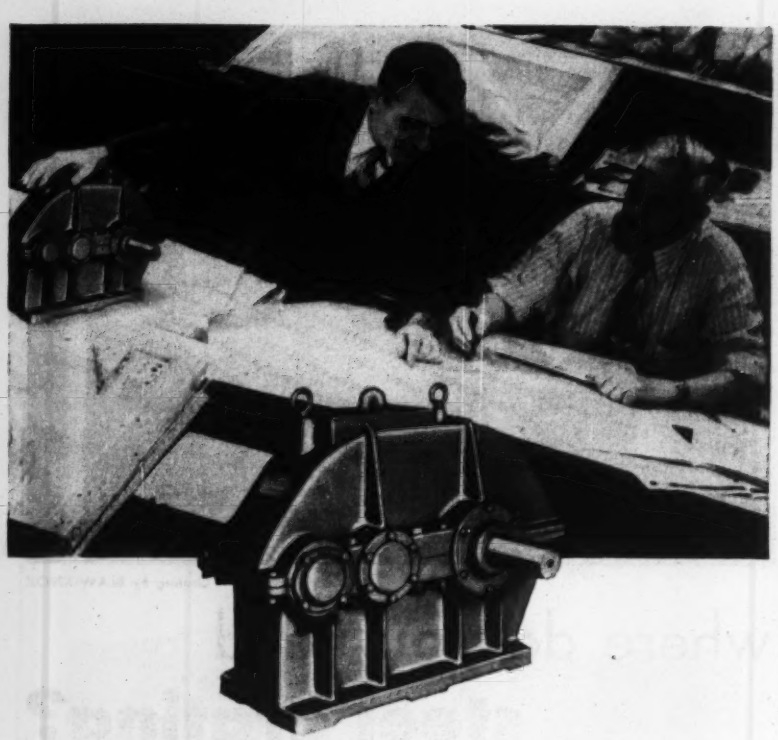
A short note will bring you a copy of new Bulletin No. 2365-R —a dimensional sketch will bring you a quotation.

BLAW-KNOX

BLAW-KNOX COMPANY
2105 Farmers Bank Building • Pittsburgh 22, Pennsylvania

BLAW-KNOX EQUIPMENT DIVISION
GRATING DEPARTMENT

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating.



"...these speed-reducer features pay off design-wise with stamina, compactness, efficiency"

You will be interested in what the engineer above is discussing with one of his staff. He's covering the machine design advantages from using Westinghouse Speed Reducers. His story tells these facts:

Fast inspection and maintenance of Westinghouse Speed Reducers is assured by the horizontal split-case construction. This design permits entire top section of case to be quickly removed. Strong case ribbing at greatest stress points means maximum rigidity and proper alignment.

Reduced friction loads, especially on starting, result from anti-friction bearings used on all Westinghouse Speed Reducers.

Exclusive heat-treating process gives all shafts, gears and pinions a tapered hardness from surface to core . . . makes gear teeth resist surface wear, yet absorb operating shocks.

Constant and proper gear lubrication is the rule with Westinghouse positive oil splash system.

Continued cool operation results from the radiation surfaces of gear case and from the large, fully protected breather on case top.

J-07342

This free book gives complete details on the full line of Westinghouse Speed Reducers. It will be sent by return mail. Write for B-5646 to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

YOU CAN BE SURE...IF IT'S Westinghouse

Gas-Oil Burners

Combination oil and gas burners for industrial applications are described in a 28-page bulletin issued by The Engineer Co. A number of alternate arrangements are shown. Some ten arrangements of registers and burners are illustrated by sectional drawings and photographs.

Copies will be sent upon request from The Engineer Co., 75 West St., New York 6, N. Y., for Bulletin OB-53.

Gear-Grinding Machines

An eight-page illustrated catalog on Gear-grind Machines has been announced by The Gear Grinding Machine Co., 3901 Christopher, Detroit 11, Mich. It provides information on the line of machines as well as types and specifications of gears, splines, and special-contoured parts that can be ground on them.

Features are described and illustrated. The catalog can be obtained by writing on company letterhead to the company.

Heat-Exchanger and Condenser Tubing

A folder of particular interest to those involved in the design, manufacture, and application of heat exchangers and condensers has been issued by the Tubular Products Div. of The Babcock & Wilcox Co.

Known as TB 329A, the folder lists the analyses and mechanical properties of 29 carbon, alloy, and stainless tubing steels used in various types of heat exchangers and condensers. Additional data presented in other tables include reference specifications and applications information.

Copies of this data folder are available free upon request to the division's general sales offices at Beaver Falls, Pa.

Temperature Indicators

A new eight-page Bulletin A-303, issued by The Foxboro Co., Foxboro, Mass., describes two portable temperature indicators, the potentiometer indicator and the resistance thermometer. These instruments are used for periodic temperature tests in equipment such as heating units and test furnaces which may not warrant continuous measurement.

Described are operating adjustments, features of design, test circuits, measuring elements, and instrument specifications. A page is devoted to listing the standard scales available, covering temperatures from −200 F to 2800 F. Tables also list the type of thermocouple or resistance bulb recommended for each range, as well as the degrees of temperature indicated by each scale division.

Also covered is the use of portable pyrometers in checking installed pyrometric instruments and in replacing potentiometers which are temporarily out of service. Copies of Bulletin A-303 will be sent on request.

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Weldless Rolled Rings

Eight ways to improve product design through use of weldless rolled rings are explained in a folder released by Ladish Co., Cudahy, Wis.

Described and illustrated are rings in sizes up to 240 in. and weights up to 40,000 lb. Available in square, rectangular, and contoured cross sections, it is reported that Ladish Weldless Rolled Rings offer great design latitude and savings in metal and machining time.

Advantages are presented in concise manner along with typical applications, which include rotary kilns and driers, jet engines, ring gears, heat exchangers and vessels, sheave rings, tanks, and log barking drums. Requests should be addressed to Ladish Co., Dept. NR, Cudahy, Wis.

Calculating HP Capacity of V-Belt Drives

A six-page interim bulletin which provides in condensed form information on a new method of calculating the horsepower capacity of a Texrope v-belt drive has been released by Allis-Chalmers Mfg. Co.

The belt ratings resulting from this new method take into consideration effect of belt length, ratio of the diameters of both the driving and driven sheaves upon the horsepower rating of the belt, and resultant belt life.

A-C states that all sheave and v-belt manufacturers in the industry have approved and accepted the belt horsepower ratings derived from this formula. Copies of this advance bulletin, "Guide for Figuring 'Texrope' Drives," 20B6956B, are available on request from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

Multiple-Plunger Pillar Presses

An eight-page, $8\frac{1}{2} \times 11$-in. folder published by Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., gives details on the company's line of multiple-plunger pillar presses. Specifications and capacities are given in tabular form for six sizes of presses.

The bulletin illustrates several sizes of the machines and pictures examples of the type of work produced on them. Close-up views show details of important portions such as the tooling arrangement.

Included are descriptions of the design features: automatic work control, accessible tooling and independent tool adjustments, roll feeds, finger motion with safety device, air clutch, etc.

Information is also given on accessory equipment such as straightener and feeder, scrap winder, and scrap cutter. A standard Waterbury Farrel scrap winder is illustrated.

Copies of this bulletin are available on request from Waterbury Farrel Foundry & Machine Co., Waterbury, Conn.

Making Warm Friendships on Hot Jobs

WATER JACKETED APCO PUMP
Developed especially for the efficient handling of high temperature and highly volatile liquids. Delivers outstanding performance. Unbeatable on high head, small capacity duties.

PUMPS "by Aurora"

For Every Purpose

APCO Turbine-Type PUMPS
—ideal for "1001" duties where small capacities and high heads predominate. Get acquainted.

AURORA CENTRIFUGAL PUMPS
are available in many types and sizes—all noted for their streamline coordination between impellers and shells.

We Invite Your Special Pump Problems

Write for CONDENSED CATALOG "M"

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AURORA Always PUMPS — AURORA PUMP COMPANY

DIVISION OF THE NEW YORK AIR BRAKE COMPANY

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Save Draftsmen's Time

YOUR TYPIST CAN DO THE JOB BETTER

Handles anything up to 12 feet!

The Vari-Typer lettering machine is the fastest and most economical method of lettering specifications on tracings and drawings. It is four to five times faster than hand lettering and is operated by an office typist. Every letter and figure is uniformly clear and distinct. Instantly changeable type, with hundreds of different styles to choose from in sizes ranging from 6 point to 18 point. Write today for information.

Vari-Typer Lettering Machine

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Newark 5, N.J.

Please send Vari-Typer Book 22

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COMPANY.....
ADDRESS.....
CITY.....ZONE...STATE...

Metal Bellows

A 16-page, two-color catalog, "Flexon Bellows Design Guide," has been released by Flexonics Corp. The catalog covers manufacture, design, applications, and specifications for Flexon Bellows. Flexon Bellows are available in stainless steel, monel, brass, and other metals. Inquiries should be sent to Flexonics Corp., 1305 S. Third Ave., Maywood, Ill., requesting catalog number 140.

Aluminum Impact Extrusion

A booklet covering the significant facts necessary to design products as impact extrusions has been issued by the Aluminum Co. of America.

Alcoa Impacts are one-piece, seamless, semi-hollow, or solid parts having forged bases and one or more extruded side walls. These parts may have round, square, rectangular, or oblong cross sections with ribbed, beaded, or fluted side walls, and bases containing bosses, lugs, other projections, or recesses.

The 16-page booklet, *Alcoa Impact Fac Book*, may be obtained by writing to Aluminum Co. of America, 724 Alcoa Bldg., Pittsburgh 19, Pa.

Conveyor Guide Rails

The United States Gasket Co., Camden 1, N. J., has issued a bulletin on their Teflon-Faced Steel Guide Rails for conveyors and packaging machines.

Designed to replace ordinary guide rails which had a tendency to adhere to and damage products and mar packages in transit, these Guide Rails have Teflon cemented to their surface by a patented USG process. Bulletin No. GR-301 will be sent on request by the United States Gasket Co.

Flexible Stainless Steel Tubing

Flexible stainless steel tubing developed to convey a variety of searching and corrosive liquids and gases at high temperatures is described in a bulletin released by The American Brass Co., American Metal Hose Branch.

The manufacturer reports wide use of this tubing by industry for absorbing vibration, compensating for misalignment, connecting moving parts, and where flexing and motion are required. Data on various types of construction, size and weight ranges, burst pressures, bending diameters, and fittings available for assemblies are included. Bulletin STC-1 is available without charge from The American Brass Co., American Metal Hose Branch, 698 S. Main St., Waterbury 20, Conn.

Valves and Filters

Asco Solenoid Valves are described in Catalog No. 24, which includes a valve-selection chart of recommended valves for classes of fluids, flow charts, and general information and terms for the valve user. Safety shut-off and manual reset valves, packless and packed valves, three-way valves, pilot-controlled valves, four-way valves, and strainers and filters are covered. Information is given on the line of Asco Midget Solenoid Valves, including the Midget 4 Way, said by the manufacturer to be one of the smallest on the market.

Special Bulletin 8336, "Solenoid Pilot-Controlled Valve," Bulletin 8035, "Pressure-Operated Manual-Reset Valve," Publication 502, "Automatic Transfer Switches," and a Valve-Delivery Schedule for orders, all printed separately, are available, from the Automatic Switch Co., 391 Lakeside Ave., Orange, N. J.

Self-Contained Flow Regulator

A self-contained flow-regulating device for clean gas-free liquids is described and illustrated in Fischer & Porter Co.'s Catalog No. 10-F-70, four pages. A constant flow rate is maintained by means of energy derived from the flow stream itself, without external power supply, according to the manufacturer. The regulator is unaffected by position, it is claimed, and may be equipped with a diaphragm motor valve for remote setting of control point.

Catalog No. 10-F-70 is available on request from Fischer & Porter Co., 49 Jacksonville Rd., Hatboro, Pa.

Instruments

An eight-page, illustrated, two-color folder on Schaevitz measuring, indicating, recording, and controlling devices for use in many different industries has been published by Schaevitz Engineering, Camden 1, N.J.

Included in the folder are descriptions and illustrations of linear and angular accelerometers for evaluating the performance of vehicles, structural members, and accessory equipment; linear variable differential transformers for the determination and control of mechanical quantities in scientific and industrial operations; rotary variable differential transformers for continuous measurement and remote indication of the angular position of rudders, control surfaces of aircraft, valves, and similar equipment; pressure transducers for measuring gage, absolute, or differential pressure; and rotary accelerators for acceleration testing and one-to-five channel recorder systems for recording related information on a single recorder chart. Technical data accompanies product descriptions, and line drawings to show application are included in many instances.

Free copies of the Schaevitz eight-page folder are obtainable from Schaevitz Engineering, P. O. Box 505, Camden 1, N.J.

WISCONSIN-POWERED HAISS CAR UNLOADER

Speeds Up Material Handling

Power TO FIT THE JOB — Power TO FIT THE MACHINE

This Haiss Model 501 combination chain- and belt-type Car Unloader, made by the George Haiss Mfg. Co. division of Pettibone Mulliken Corp., provides another typical example of a time- and cost-cutting Wisconsin Engine power application.

Wisconsin Heavy-Duty Air-Cooled Engines have the "engineered-in" Lugging Power that stays with the job. When sudden shock loads slow down the engine speed and the torque builds up, your Wisconsin Engine *hangs on* and pulls through without stalling. Heavy-duty engineered design and construction, plus trouble-free AIR-COOLING, are factors that keep the work moving on schedule at all seasons, in all climates.

You can't do better than to specify "Wisconsin Power" for your equipment. Available in 4-cycle single cylinder, 2- and 4-cylinder models, in a complete power range from 3 to 36 hp.

V-type 4-cylinder 15 to 36 hp.

MOST H.P. HOURS

WISCONSIN MOTOR CORPORATION

World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

Blow-Off Valves

Catalog 12-D1, published by Edward Valves, Inc., subsidiary of Rockwell Mfg. Co., features a redesigned line of blow-off valves with flanged or welding ends and bolted bonnets for 300, 400–600, 900–1500 lb sp classes plus the addition of welded bonnet blow-off valves with welding ends for 1500 and 2500 lb sp classes.

The new line, according to the company, retains such features as interchangeability of parts, line contact backseats, condensate cooling chamber to protect the packing, both valves in a set capable of tight shut-off, and self-centering disk with swivel construction. Some of the new features include improved streamlining of interior body contours, swing gland bolts for easier repacking, and stellited seating surfaces for lower pressure classes.

"What You Should Know About Blow-Off Valves" is the title of an article included in the catalog. Two pages are devoted to tips on selection, operation, and installation of blow-off valves and the boiler code requirements for them.

The catalog is illustrated with installation photographs, line drawings, and cut-away views. Tables on material specifications and flanged and welding end details, as well as valve descriptions and a partial list of current users of Edward steel blow-off valves, are included.

Copies may be obtained from an Edward representative or by writing directly to Edward Valves, Inc., 1211 West 145th St., East Chicago, Ind.

Air and Hydraulic Cylinders

Bulletin 800 covers air and hydraulic cylinders of heavy-duty construction manufactured by the Lindberg Air & Hydraulic Div., Lindberg Engineering Co., 225 N. Laflin St., Chicago 7, Ill.

The air cylinders, for 150 psi maximum air pressure, are made in eleven bore sizes from 2 in. to 12 in. in diam, and in seven mounting styles. The hydraulic cylinders, for 1500 and 3000 psi, come in ten bore sizes from 2 in. to 8 in. in diam, and are obtainable in eight mountings.

Extra-heavy-duty mill-type air cylinders, for 250 psi maximum air pressure, in 13 sizes from 3-in. to 24-in. diam and six mountings, are also manufactured by Lindberg.

The bulletin will be sent on request to the company.

Additional Opportunities for positions are offered among the display advertisements on pages 46, 50, 56, 60, 62 and 128

D-C Runout-Table and Coiler Motors

A new eight-page bulletin describing d-c motors for runout-table and coiler-roll applications has been announced by the General Electric Co., Schenectady 5, N. Y.

Gear Lappers and Lapping

Two pages of an eight-page Michigan Tool Co. bulletin are devoted to a discussion of gear lapping problems and their solutions. This bulletin, offered by the Michigan Tool Co. 7171 E. McNichols Rd., Detroit 12, Mich., also presents a concise explanation of the lapping process. Two external and two internal gear lapping machines are illustrated and their features, specifications, and capacities are described.

Both Michigan Internal and External Gear Lappers operate on a crossed-axis principle, using rotating laps in mesh with the work gears while they are reciprocated across the gear face. Where relatively small internal splines are to be lapped, the Internal Lapper operates on a parallel-axis principle, which uses a lap with the same number of teeth as the spline to be lapped; the work part and the lap being rotated together as the lap reciprocates across the spline face.

15-100-Hp Packaged Automatic Boilers

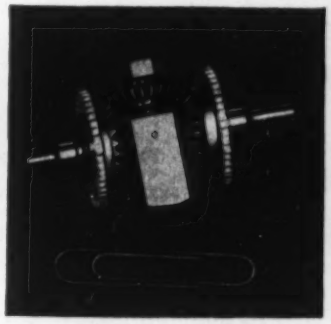
An 8-page bulletin has been published by Orr & Sembower, Inc., Reading, Pa., on a new line of simplified Powermaster packaged automatic boilers for firing light oil or gas. The oil-firing equipment is a simplified mechanical pressure-atomizing burner. For gas firing a specially designed pre-mixing gas burner is utilized. Combination units adaptable to firing either gas or oil may be obtained. The new unit is built in nine sizes from 15 hp through 100 hp, covering steam requirements to about 3450 lb/hr as well as hot-water designs. Details of design and construction, cutaway view, and sample specifications are contained in the bulletin.

The Powermaster is a three-pass boiler with a single flue-gas flow reversal at either end. A minimum of 5 sq ft of heating surface is provided per boiler horsepower, the manufacturer reports. Programming and safety controls are automatic.

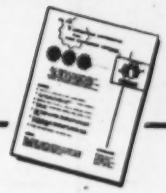
Orr & Sembower, Inc., Morgantown Rd., Reading, Pa., will send, on request, Bulletin 1230 on the Model 4 Powermaster packaged automatic boiler for light oil or gas firing from 15 to 100 hp in steam or hot water designs for pressures to 250 psi. Other Powermasters are available to 500 hp.

the NEW

1/8" MECHANICAL DIFFERENTIAL from FORD INSTRUMENT COMPANY



- Operates in working circle of 1.000" max. diameter
- Lost motion does not exceed 12 mins.
- High sensitivity
- Stainless steel throughout; resistance to wear and corrosion
- Uses Zerol bevel gears.
- Weight, with typical end gears, is less than one ounce



The 1/8" differential is the latest and smallest addition to the Ford Instrument line of single spider gear differentials. Engineered to highest military and commercial standards, this highly reliable unit provides extreme accuracy in additive and subtractive operations, while functioning with minimum friction and backlash.

WRITE FOR FULL DETAILS

Fully illustrated data sheet gives performance curves and characteristics. Please address Dept. ME.

21

FORD INSTRUMENT COMPANY
31-10 THOMSON AVENUE
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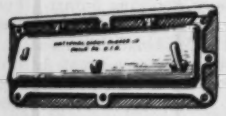
A Complete Line of

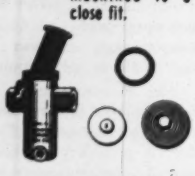
COMBUSTION
ACCESSORIES

for Every Industrial Liquid Fuel-Gas Installation



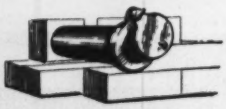
Air Control Door and Frame, top hinged, ratchet type, heavy duty, for manual control. Surfaces are machined to a close fit.

Fuel Oil Suction Strainer, single type. Large basket area insures low pressure drop; cover and basket easily removed for cleaning.



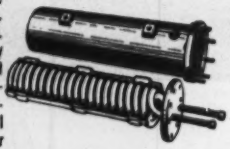
Wide-View Peephole, safety, curtain type. Cobalt glass removed to show bearing surface for curtain. Curtain halves are interlocked—open simultaneously.

Ignition Port with Refractory Tile No. M896 . . . for use with standard 3" pipe. Also serves as a peephole.



Furnace Relief and Access Door, heavy construction, practically air tight. Door casting correctly weighted, lined with plastic refractory retained by imbedded grill; with observation port and cover.

Fuel Oil Heater, Self-Cleaning, Spiral Coil Type. High oil velocity in coil, resultant turbulence prevents carbon formation. No internal connections or joints.



The "right combination" for you in achieving maximum combustion economy is: NATIONAL AIROIL Fuel Oil, Gas or Combination Oil & Gas Burning Equipment; NATIONAL AIROIL Combustion Accessories; and, NATIONAL AIROIL Engineering Consultation. May we be of help to you in accomplishing your particular installation or in solving that difficult problem?

CHEMICAL-PETROLEUM DIVISION

NATIONAL AIROIL BURNER CO., INC.

1239 EAST SEDGLEY AVE., PHILA. 34, PA.

Southwestern Division
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INDUSTRIAL OIL BURNERS, GAS BURNERS, AND FURNACE EQUIPMENT

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Filters and Expansion Joints

Bulletin No. 51, published by the Croll-Reynolds Engineering Co., 17 John St., New York 38, N. Y., gives general information and illustrations concerning the types of expansion joints manufactured by the firm, including pressure, size range, materials of construction, applications, and data required for estimating.

A separate eight-page bulletin explains the design of Croll-Reynolds' liquid-clarification equipment. Advantages claimed for these all-purpose filters are simplicity of design, high efficiency of operation, and economy in use and maintenance. Types of filters and the choice of membranes are illustrated.

Request for copies should be directed to the company.

General-Purpose Turbines

The Westinghouse Electric Corp. has reissued its 20-page booklet on Type E general-purpose turbines. Covering the complete line of Type E turbines in ratings through 1500 hp, this booklet describes design and constructional characteristics, as well as accessories which make these units adaptable to special requirements.

Application of these turbines as drives for pumps, fans, compressors, generators, paper-making machines, Jordans, beaters, coal pulverizers, and line shafts is discussed. Specification and selection data are provided.

A copy of booklet B-3896 can be obtained from Westinghouse Electric Corp., P.O. Box 2099, Pittsburgh 30, Pa.

Stationary Vacuum Systems

Bulletin A-939, released by the Air Appliance Div. of U. S. Hoffman Machinery Corp., 105 Fourth Ave., New York, N.Y., analyzes the problem of industrial dust and describes a line of vacuum cleaning equipment designed to combat it.

The basic working elements of the company's permanently installed vacuum cleaning systems with central dust collection are described in detail. The 12-page, two-color booklet also explains and illustrates coordinated vacuum cleaning accessories, including tools, hose, and a newly developed storage locker. Portable separators, water traps, material intake valves, electric bag shakers, and rotary discharge valves are individually described. The function of each is explained in the section on auxiliary equipment.

Portable vacuum cleaning units ranging from $1\frac{1}{2}$ to $7\frac{1}{2}$ hp are pictured. Brief mention is made of the adaptability of vacuum cleaning systems to the collection and conveying of dry materials.

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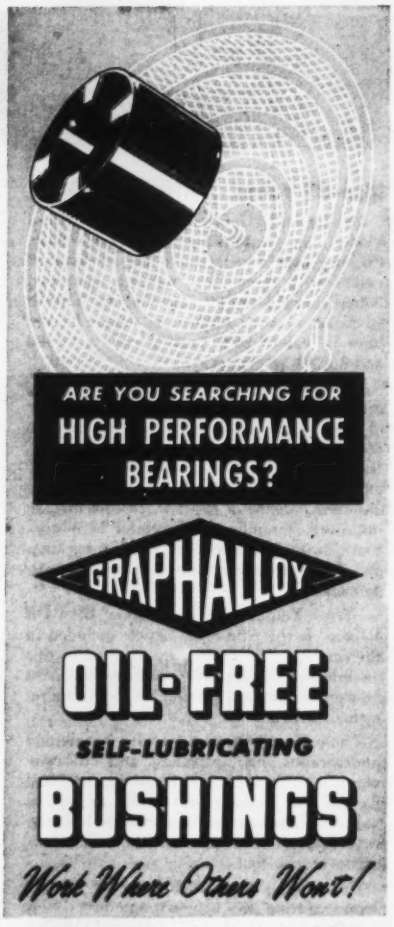
For QUICK Results



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GRAPHALLOY

OIL-FREE
SELF-LUBRICATING
BUSHINGS

Work Where Others Won't!

EXCELLENT DURABILITY • CONSTANT COEFFICIENT OF FRICTION • APPLICABLE OVER A WIDE TEMPERATURE RANGE — EVEN WHERE OIL SOLIDIFIES OR CARBONIZES • OPERATE DRY, OR AT HIGH SPEEDS SUBMERGED IN WATER, GASOLINE OR OTHER LIQUIDS • EXCELLENT FOR CURRENT-CARRYING BEARINGS

GRAPHALLOY materials are also in wide use for oil-free, self-lubricating piston rings, seal rings, thrust washers, friction discs, pump vanes, etc.

Other Graphalloy Products

For applications requiring low electrical noise, low and constant drop, high current density and minimum wear. Used for SELSYNS, DYNAMOTORS, SYNCHROS, ROTATING STRAIN GAGE pick-ups and many other applications. Brush Holders and Coin Silver Slip Rings also available.

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1058 NEPPERHAN AVE. • Yonkers, New York

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☐ Send data on BRUSHES and CONTACTS.

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KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Blowers

The Diamond Power Specialty Corp., Lancaster, Ohio, has issued a General Catalog entitled "Diamond Power Products." It contains descriptive bulletins and technical information on Model IK Long-Travel Retracting Blowers, Model IR Short-Travel Retracting Blowers, Model G9B Fixed-Position Rotating Blowers, Model A2E Air-Puff Automatic Blowers, Bi-Color Gages and Water Columns, and Diamond "Utiliscope" (Wired Television). Request should be made for Catalog 1113.

Surface Finishing, Ovens

Finishing systems, including spray, dip, or flow coating, cleaning, pickling, and rust-proofing systems, and spray booths, drying and baking ovens, dust collectors, and fog filters are illustrated and described briefly in R. C. Mahon Co.'s Catalog No. A-654.

Special emphasis is placed on Mahon's Rotodip finishing systems, which combine cleaning, rust-proofing, drying, coating, and baking operations in a continuous operation.

Copies of the 12-page catalog are available on request from The R. C. Mahon Co., Detroit 34, Mich.

Industrial Filtration

A new bulletin has been announced available on Delpark Industrial Filters. Major features are dimensions and capacities of the various Delpark Filters available for industrial applications. Delpark Filters feature continuous, full-flow, self-cleaning, fully automatic disposable-belt-type filtration, the manufacturer states. Applications include filtration of quenching oils, coolants, and paint spray booth water. Requests should be addressed to Mr. George L. Guymon, Vice President, Industrial Filtration Co., Dept. 200, Lebanon, Ind.

Cam Clutches

A four-page, two-color, 8½ × 11-in. catalog, C12–54, describing Series 200 Morse cam clutches for indexing, overrunning, and backstop machine drive applications, is available from Morse Chain Co., 7601 Central Ave., Detroit 10, Mich.

Application data, typical installation drawings, and a table of specifications are given for seven models of clutches having torque ratings from 10 to 500 ft-lb; ground OD dimensions correspond to standard 200-series ball bearings in nominal sizes from 1½ to 3½-in. OD.

Aluminum in the Electrical Industry

A four-page brochure published by Reynolds Metals Co. outlines its expanded facilities for producing wire, cable, and bus conductor for the electrical industry.

Reynolds' Listerhill, Ala., plant is featured, where over 200,000 sq ft of floor space is devoted to wire and cable manufacture.

Copies of this brochure may be obtained without cost by addressing requests to Reynolds Metals Co., 2500 S. Third St., Louisville 1, Ky.

Gravity Filters

The Permutit Company has published Bulletin 2539A, 24 pages, said to be of interest to all operating, consulting, and mechanical engineers dealing with water problems. It shows the Permutit line of rapid-type gravity filters, which are made in three basic types of concrete, of wood, and of steel. Specifications, operating characteristics, outline dimensions, and typical installations of the filters and associated accessories have been included.

Inquiries should be directed to The Permutit Co., 330 West 42nd St., New York 36, N.Y.

AERODYNAMIC PROBES

- We design and build thermocouples, pressure, velocity, direction and hot wire anemeter probes to solve your flow measuring problems.
- Probes made to your specific design.
- Aerodynamic Calibrations for all probes.
- Complete temperature and pressure measuring systems for your tests.
- Facilities for manufacturing large quantities of thermocouple probes.

FLOW INSTRUMENTATION for TURBO JET, RAM JET or ROCKETS.

Our engineering staff is familiar with problems in fluid flow measurement. For further information write Dept. 5.

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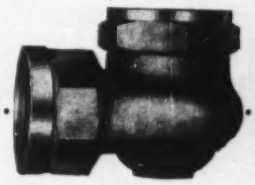

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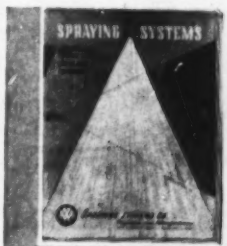
Modern design. Precision machining. All materials. Thousands of standard industrial spray nozzle types and sizes to choose from. Years of proved experience at your service.



write for this great new catalog today

Ask for our new 48 page Catalog No. 24 . . . the most comprehensive spray nozzle catalog ever produced. Yours for the asking.

SPRAYING SYSTEMS CO.
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KEEP INFORMED — NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Fractional-Horsepower Gears

Gear Specialties, Inc., has released an 8½ × 11-in., six-page, two-color folder, punched for ring binders. It shows where and how G.S. fractional-horsepower gearing is mass-produced to a degree of uniform accuracy claimed unapproached in the history of the industry. The folder contains 23 photographs of small-gear applications and plant views, together with diametral- and circular-pitch tables. Requests for copies, on company letterhead, should be sent to Gear Specialties, Inc., 2635 W. Medill Ave., Chicago 4, Ill.

Metal Working and Forming

The Eastern Tool & Mfg. Co. has published an illustrated 24-page booklet "Wire Forming, Metal Stamping, and Deep Drawing," on the operations of the company, which specializes in metal working and forming.

Beginning with a brief history, the bulletin covers with photographs and text the firm's work in research and development, tool design, wire forming, loops and slides, metal stamping, deep drawing, plating, and finishing.

Requests for copies should be addressed to the Eastern Tool & Mfg. Co., Belleville, N. J.

Valves for Instrument Piping

Data Unit 234 gives features, application information, and specifications on Jerguson Valves for instrument piping and general use. This four-page Data Unit contains illustrations and drawings showing how these valves combine unions, nipples, reducers, elbows, tees, valve, and drain valve into one unit. Copies are available from Jerguson Gage & Valve Co., 80 Fellsway, Somerville 45, Mass.

Packaged Water-Tube Steam Generators

Union Iron Works has issued a 16-page Bulletin MH3-54 which describes the shop-assembled Union Type MH Steam Generators, furnished for oil or gas firing or both, with automatic, semi-automatic, or manual combustion controls. Included are: tube arrangement layouts, installation photos, cutaway illustrations, optional equipment available, and a dimension table for the 13 standard sizes ranging in capacity from 10,000 to 40,000 lb of steam per hr.

General Bulletin No. 153, covering the complete Union line of field-erected boilers, is also available.

Requests for either bulletin should be sent to Union Iron Works, Erie, Pa.

Electrified Log-Carriage Drives

Two bulletins on completely electrified log-carriage drives with amplidyne control have been announced as available from the General Electric Co., Schenectady 5, N. Y.

A two-color eight-page publication, designated GEA-5786, describes how the log-carriage drive operates and contains information on its advantages, maintenance, and operating cost.

The other bulletin, GEA-5992, provides four pages of information on speed variator amplidyne-controlled log-carriage drives.

Industrial Engines

A 44-page booklet on the Lycoming Co. and its products has been announced by the Lycoming Div. of Avco Mfg. Corp., Stratford, Conn.

Among the products and processes described and illustrated are turbine engines, industrial engines, tank engines, hardened and ground precision parts, gears and machined parts, generator sets, heat treating and plating, steel fabrication, castings, and heating boilers.

Many photographs and drawings illustrate the booklet, which is available on request.

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PRESS STYLE STEEL TYPE HOLDER
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Write for Catalog 100
Body and press shank are one piece with flanges to hold type chase in position. Type chase with almost any size or number of characters can be removed and inserted without operator placing hands in press.

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Model 10VA

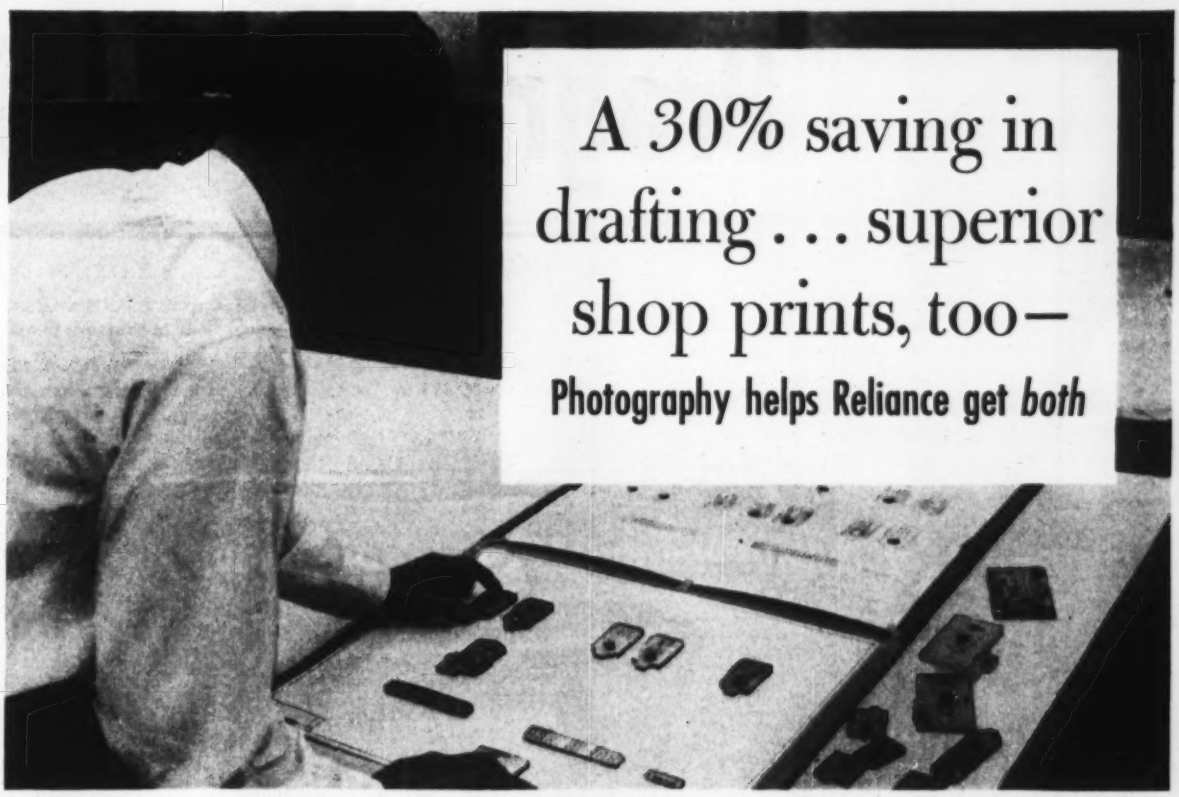
One of the Ten Models of ALL AMERICAN Vibration Fatigue Testing Machines

The "10VA" produces vibration vertically in simple harmonic motion—from 10 to 55 cycles per second on automatic control and from 10 to 60 c.p.s. on manual control. Table load capacity 10 lbs. at 10g. Has 50% overload factor. Tests components, assemblies, products—exposes danger points—forestalls failures in the field. Simple to operate. Essential for today's inspection, testing, research. Also models with horizontal table motion. Send for Bulletin 551.

Manufacturers of All American Precision Die Filing Machines

ALL AMERICAN Tool & Manufacturing Co.

8019 Lawndale Avenue, Skokie, Ill.



A 30% saving in drafting . . . superior shop prints, too—

Photography helps Reliance get *both*

At the Reliance Electric & Engineering Co., Cleveland, Ohio, the use of photographic templates and Kodagraph Autopositive Paper has helped to lower drafting-room costs by at least 30%, besides assuring highly legible shop prints day in and day out.

The templates—on clear plastic—represent the designs of standard components that appear again and again in Reliance's many wiring diagrams. A draftsman uses them, first, to make a preliminary drawing – positioning the templates he needs on whiteprint paper, making a print, then roughing in the hook-up lines.

After this drawing has been approved, he prints the templates on Kodagraph Autopositive Paper, using a printing frame. Simple photographic processing—under normal roomlight—produces a positive print of the layout directly. All he has to do now is add the hook-up lines, and another drawing is ready for Reliance's file of photo-lasting Autopositive "originals." *Another saving can be chalked up!*

Reliance has found these photo-drawings to be ideal printing intermediates. They're evenly translucent, durable; have crisp, dense black lines. And they produce top-quality shop prints at practical, uniform speeds in Reliance's direct-process machine.

Learn how thousands of companies are simplifying drafting and drawing reproduction routines, and protecting valuable originals with Kodagraph Autopositive Paper. See how you, or your local blueprinter, can process this sensational material quickly, at low cost. Mail coupon today.

Kodagraph Autopositive Paper

"THE BIG NEW PLUS" in engineering drawing reproduction

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EASTMAN KODAK COMPANY, Industrial Photographic Division, Rochester 4, N. Y.

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Progress is built

Fairbanks-Morse will also continue to supply electric motors in *old* NEMA frame sizes.

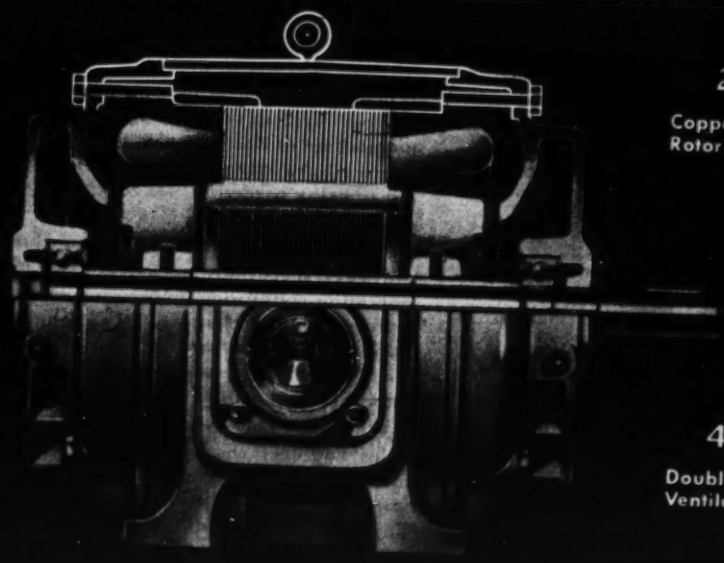
...brick by brick

The new NEMA Standard for electric motors is a significant sign of progress to all industry—More Power in Less Space.

But progress—to be lasting—must be built brick by brick For more than a century, Fairbanks-Morse designers have held to the ideal of more performance in less space. They have produced outstanding advancements in the design of diesel engines, pumps, scales, locomotives and the many other products that feature F-M exclusives. Fairbanks-Morse electric motors built on this basic F-M engineering philosophy are continuing assurance of operating economy and efficiency.

Look for the electric motor that stands on this Fairbanks-Morse solid foundation of design progress. It carries the Fairbanks-Morse Seal of Quality.

NEW FAIRBANKS-MORSE GUARDED DRIPPROOF MOTORS



1 Guarded, dripproof construction keeps falling objects and dripping liquids out of motor in any mounting position—maximum motor protection under conditions of wet or dirty operation—indoors or out.

2 Exclusive Fairbanks-Morse feature that provides a virtually indestructible one-piece rotor—homogeneous, free from flaws and gas inclusion for maximum strength and lifetime service.

3 Oversized, precision ball bearings in spacious housings, sealed against grease leakage. Contain ample lubrication for extended periods of rugged service. Convenient flushing and re-lubricating available if desired.

4 F-M exclusive design eliminates hot spots. Cooling outside air is drawn into motor through openings in lower portion of both bearing arms and circulated through cored passages in the frame.

5 New, gasketed, cast iron conduit box permits easy pulling of cables without insulation damage. Fairbanks-Morse exclusive: recess feature allows elimination of conduit box where space is limited.

FAIRBANKS-MORSE
a name worth remembering when you want the best

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Construction Machinery

Assembly Conveyors

Drilling Equipment

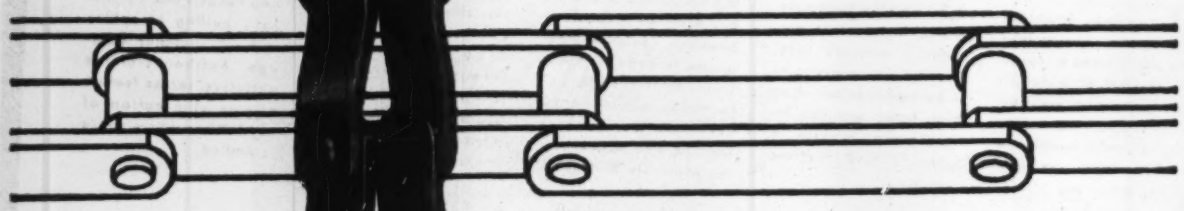
Heat-Treating Furnaces

When COST is an OBJECT

Whether that cost is first or operating, it will pay dividends to investigate the saving possibilities of Rex Chabelco Steel Chain. It has the *extra* strength, *extra* stamina and *extra* quality needed for longer trouble-free operation.

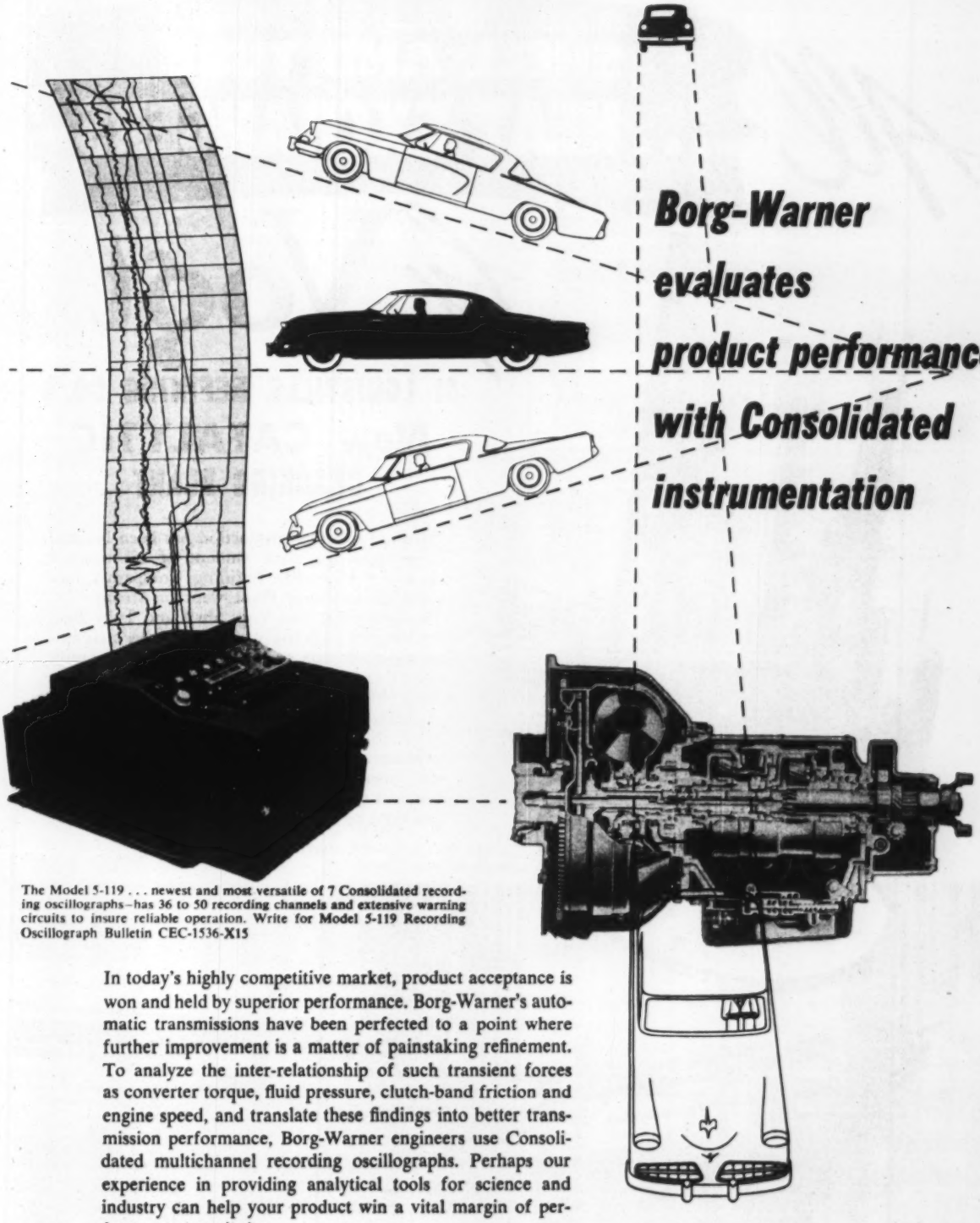
For drive or conveyor service, where loads are heavy, speeds slow to moderate . . . where operating conditions involve temperature extremes, dust, dirt or heavy shock loads—*these steel chains will save you important money.* And, they run on cast sprockets . . . another important cost-cutting advantage.

Why not have your Chain Belt District Sales Engineer check your chain requirements with you. He may be able to save you important money—he has for other Design Engineers. Meanwhile, send for Bulletin 53-59. Chain Belt Company, 4765 W. Greenfield Ave., Milwaukee 1, Wisconsin.



CHAIN BELT COMPANY

District Sales Offices in all Principal Cities



Borg-Warner evaluates product performance with Consolidated instrumentation

The Model 5-119 . . . newest and most versatile of 7 Consolidated recording oscillographs—has 36 to 50 recording channels and extensive warning circuits to insure reliable operation. Write for Model 5-119 Recording Oscillograph Bulletin CEC-1536-X15

In today's highly competitive market, product acceptance is won and held by superior performance. Borg-Warner's automatic transmissions have been perfected to a point where further improvement is a matter of painstaking refinement. To analyze the inter-relationship of such transient forces as converter torque, fluid pressure, clutch-band friction and engine speed, and translate these findings into better transmission performance, Borg-Warner engineers use Consolidated multichannel recording oscillographs. Perhaps our experience in providing analytical tools for science and industry can help your product win a vital margin of performance superiority.

Consolidated Engineering

CORPORATION

300 North Sierra Madre Villa, Pasadena 15, California

Sales and Service through **CEC INSTRUMENTS, INC.**, *a subsidiary with offices in: Pasadena, Chicago, Dallas, Detroit, New York, Philadelphia, Washington, D. C.*

ANALYTICAL INSTRUMENTS FOR SCIENCE AND INDUSTRY

All SHELL AND TUBE ...HEAT EXCHANGERS by Vogt

ABOVE: View of new construction at Louisville Refining Company.

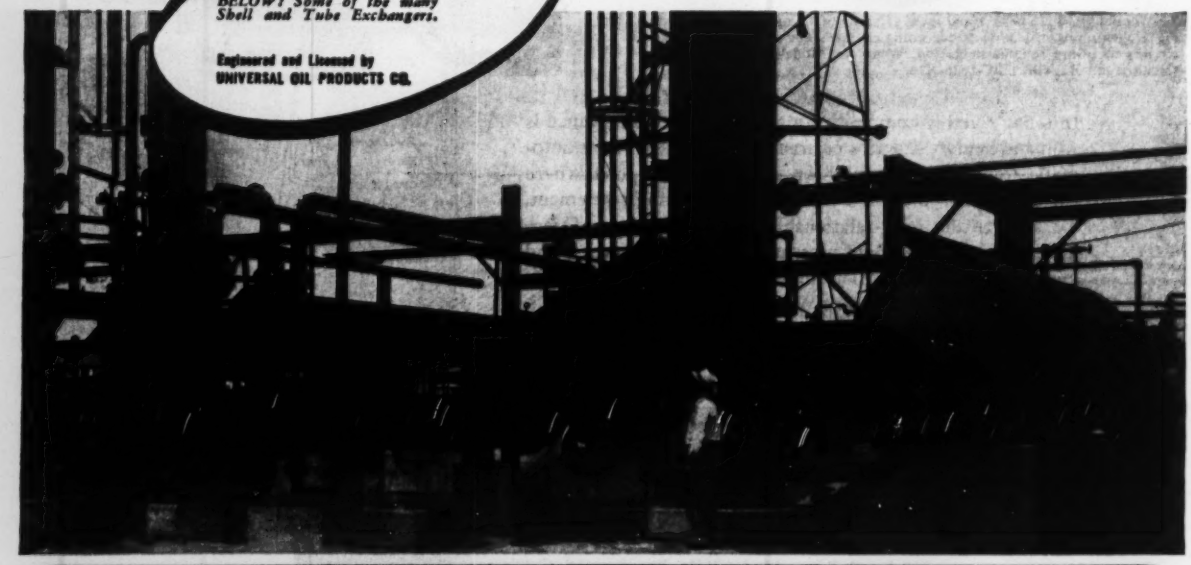
BELOW: Some of the many Shell and Tube Exchangers.

Engineered and Licensed by UNIVERSAL OIL PRODUCTS CO.

At LOUISVILLE REFINING CO.'S New CATALYTIC CRACKING PLANT

Premium gasoline production has been boosted 20% from the same amount of oil charged since the Louisville Refining Company's new Catalytic Cracking Plant went on stream.
The new plant uses Vogt Shell and Tube Heat Exchangers exclusively and they make a significant contribution to the efficient and economic operations of this progressively modern refinery.
Vogt Shell and Tube Heat Exchangers are available in many different types, with fixed or removable tube bundles, to meet the special problem and specific operating conditions of each installation. They are constructed from carbon and special steels to meet every temperature, pressure, or vacuum service requirement.

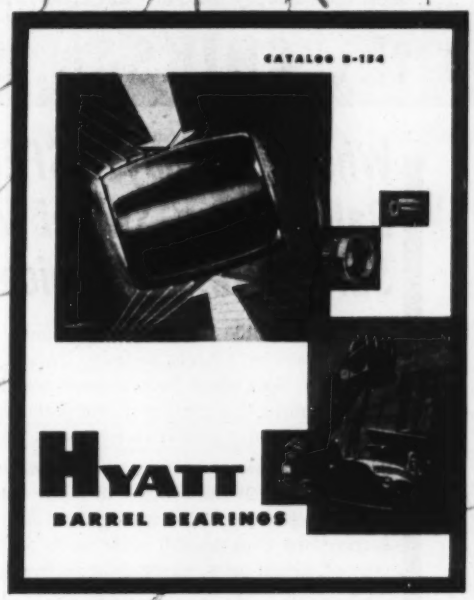
WRITE FOR BULLETIN HE-6

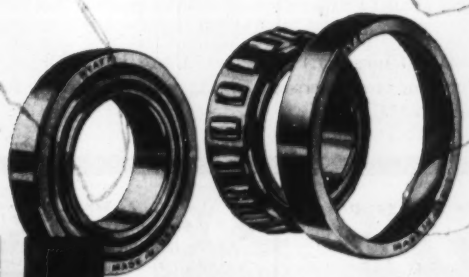


HENRY VOGT MACHINE CO. Louisville 10, Ky. • BRANCH OFFICES: NEW YORK, PHILADELPHIA, CHICAGO, CLEVELAND, ST. LOUIS, DALLAS, CHARLESTON, W. VA.

Always within easy reach . .

Hyatt's New Line of Dual-Purpose, Self-Aligning BARREL BEARINGS!



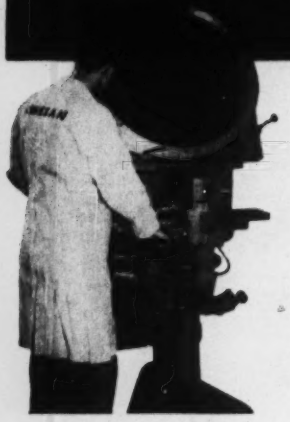


Got a bearing problem? Just reach for Hyatt's new Barrel Bearing Catalog! This is one catalog engineers have been waiting for, because it's essentially *a guide to lower maintenance costs!* Barrel Bearings are not only dual-purpose in design; they're also *self-aligning*. They operate with full efficiency under misalignment conditions which cause excessive wear in ordinary bearings. If *your* job involves bearing specifications, make sure you have Hyatt Catalog No. B-154. It puts a complete line of Barrel Bearings right at your finger tips. Write to Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

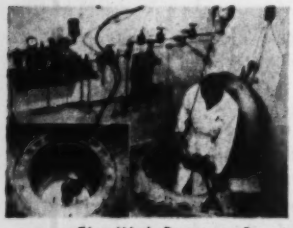
HYATT

STRAIGHT | BARREL | TAPER

CHECK & DOUBLE CHECK!



A 30" optical comparator in CHIKSAN'S Inspection Department helps further improve quality control of all swivel joint parts.



The High Pressure Burst Chamber subjects CHIKSAN joints and assemblies to 80,000 lbs. pressure to test possible material flaws.

Hydraulic fluid pressure tests of every CHIKSAN aero hydraulic swivel joint is the final check step before shipment.

When YOU buy—SPECIFY CHIKSAN Ball-Bearing Swivel Joints for Safe, Sure, Economical performance.

Check and double check is your guarantee of the finest ball-bearing swivel joints for your money. Checks include: Inspection prior to machining; Inspection by machinist; Spot check by line inspector; 100% inspection of all components before assembly; and 100% hydrostatic testing of assembled joints. This meticulous procedure insures quality control of all Chiksan products.

Through a quarter century, more than one million Chiksan joints have served satisfied users in the transfer of fluids and gases in flexible lines. Constant and continuing research and testing are your assurance that the swivel joints manufactured by Chiksan will continue to offer more for your money than any other type of swivel joint, swing joint or fitting.

Chiksan offers the largest and most complete line of swivel joints in the world. Standard sizes range from ¼" to 12" with larger sizes available on special order. Our engineers have had years of experience in solving flexible line problems in every major industry.

You can avail yourself of Chiksan's experience. There is a Chiksan office or Representative near you for close, personal assistance. Write today for catalog information. Department 6-ME.

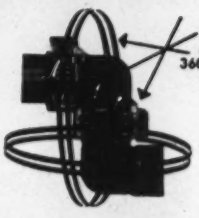
CHIKSAN

The Flow of Enterprise Relies on

CHIKSAN

Ball-Bearing Swivel Joints

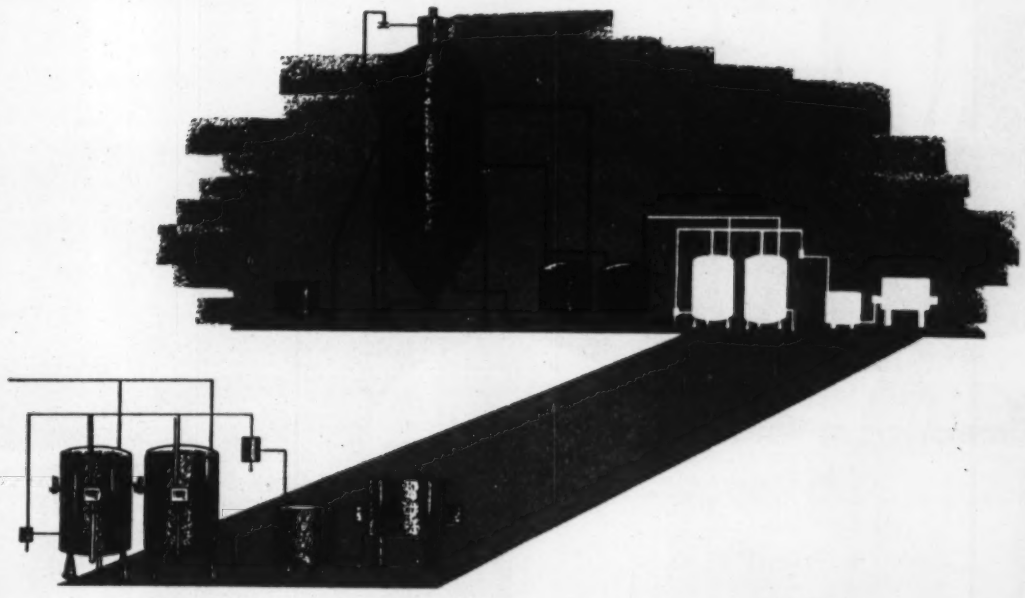
THE NEW TOOL OF MODERN INDUSTRY



CHIKSAN Ball Bearing Swivel Joints are THE NEW TOOL of Modern Industry with full 360° rotation in 1, 2, and 3 planes. Over 1,000 different types, styles, and sizes have been developed for pressures and services from 28" vacuum to 15,000 psi and for temperature ranges from minus 70° to a plus 500° F. with packing materials for each specific service.

CHIKSAN COMPANY • BREA, CALIFORNIA • Chicago 3, Illinois • Newark 2, New Jersey

Weil Equipment Mfg. Corp. (Division), Houston 1, Texas • Subsidiaries: Chiksan Export Co., Brea, Calif.; Newark 2, N. J. • Chiksan of Canada Ltd., Edmonton, Alta.



Your present or future Hot Process + Cochrane Hot Zeolite

=HIGHER QUALITY, LESS COSTLY WATER

For higher quality water from your present or future hot process softener . . . for economical modernization of boiler plants or for new plants . . . investigate the application of Cochrane Hot Zeolite to your system. Consult the pioneer and leader in the Hot Process field.

A Cochrane Hot Zeolite Softener, installed on the filter effluent of your system provides water of zero hardness, lowers alkalinity to approximately 25 parts per million and minimizes carbon dioxide in the steam. By proper treatment in the complete system silica can be reduced to low limits.

The use of high temperature resins produces substantial savings through the elimination of soda ash and reduction of phosphate.

Cochrane engineers and manufactures every type of precipitation and ion exchange water conditioning equipment, thus assuring you unbiased recommendations for equipment best suited to your requirements. Cochrane's *complete* service provides single responsibility for engineering, fabrication and continued satisfactory operation.

For further details on Cochrane Hot Zeolite Softeners, write for Publication No. 4801 and reprints on Hot Process-Hot Zeolite.

Other Cochrane Processes

DEMINERALIZER

Delivers solids-free, silica-free water at extremely low cost. Publication 5800.

JET TRAY DEAERATOR

Delivers hot deaerated water with an oxygen content not to exceed 0.005 cc. per litre—less than 7 parts per billion! Publication 3005 and 4643.

SOLIDS CONTACT REACTOR

Slurry blanket principal efficiently removes solids, turbidity, silica, fluorides, color, taste; reduces alkalinity from water for industrial and municipal purposes. Publication No. 5001-A.

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Representatives in 30 principal cities in U. S.; Toronto, Canada; Mexico City, Mexico; Paris, France; Havana, Cuba; Caracas, Venezuela; San Juan, Puerto Rico; Honolulu, Hawaii.

Pottstown Metal Products Division—Custom built carbon steel and alloy products

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City_____ Zone____ State_____

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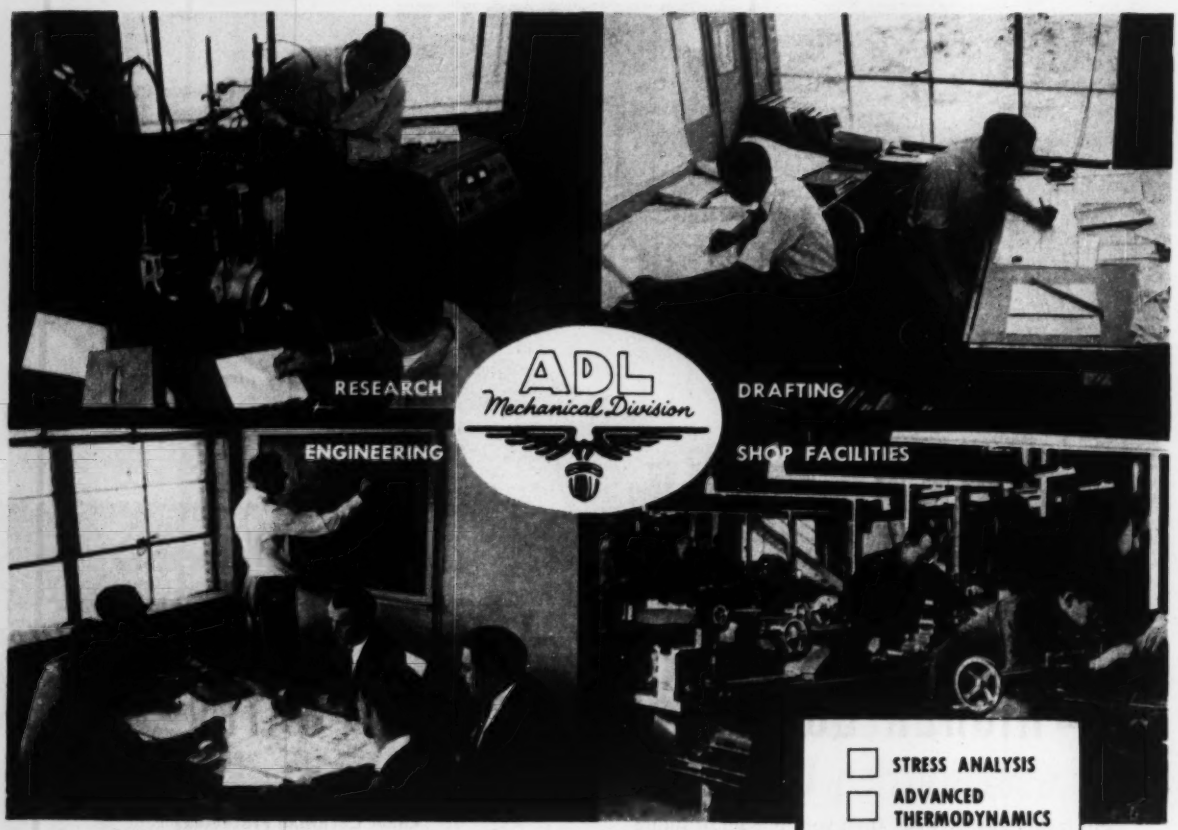

- ☐ STRESS ANALYSIS
- ☐ ADVANCED THERMODYNAMICS
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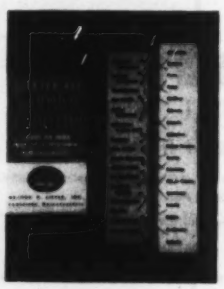
- ☐ MACHINE DESIGN
- ☐ NOISE REDUCTION

DO YOU HAVE PROBLEMS IN ANY OF THESE FIELDS?

These are fields in which our Mechanical Division can help you solve your problems . . . without adding complex facilities and highly trained personnel to your staff, for which you have only temporary use.

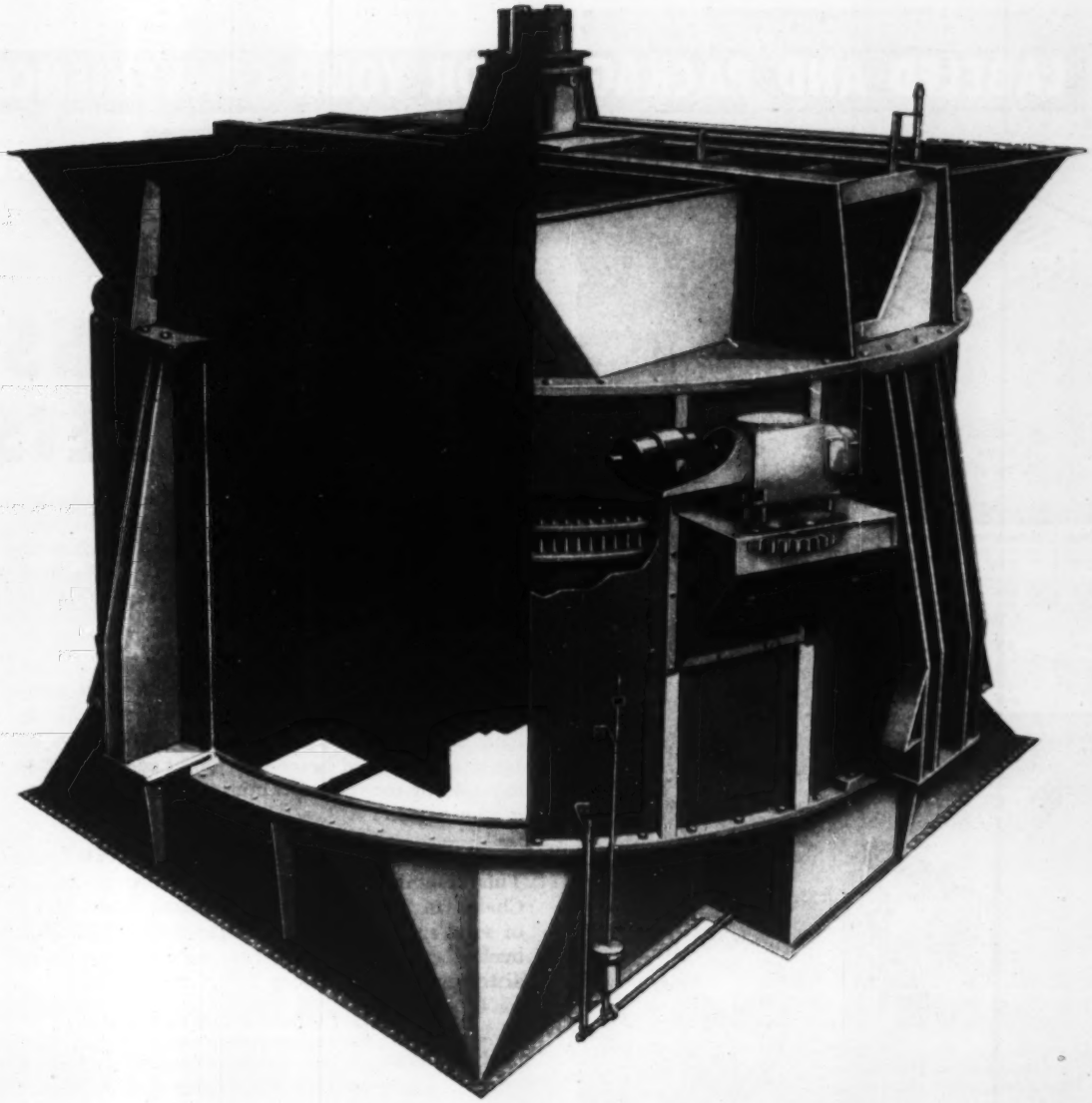
In our Mechanical Division is concentrated a greater diversity of specialized personnel and facilities than most companies can normally focus on a research or development problem. Here scientists blend their knowledge and talent with the industrial experience of engineers and other technologists. This team is ready to work with your organization on one or more of the following bases:

Basic research
Complete development after basic research
Refinement of existing equipment
Prototype construction
Construction of complete process equipment



Whether your problems are small or large, usual or unusual, new or old, outside help by our Mechanical Division can be a valuable asset to you.
WRITE TODAY for Bulletin No. XX-1.

MECHANICAL DIVISION
Arthur D. Little, Inc.
30 Memorial Drive, Cambridge 42, Mass.



THE LJUNGSTROM AIR PREHEATER

cuts fuel costs in hundreds of plants

The Ljungstrom Air Preheater has proved its value in industrial and utility plants throughout the country. That's why every year, a constantly increasing percentage of the total installed boiler capacity is Ljungstrom-equipped. *Your fuel costs will drop, too,* when you equip your boilers with Ljungstroms. The extremely high efficiency of the regenerative design means the greatest possible recovery of waste heat . . . with substantially lower fuel requirements.

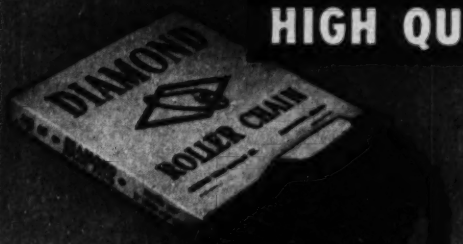
If you are planning a new boiler installation — or expanding or modernizing your present one — let our engineers show you how the Ljungstrom can raise over-all efficiency in your plant.

Ljungstrom Air Preheaters are now available for boilers of any type or capacity from 25,000 pounds of steam per hour up.

The Air Preheater Corporation 60 East 42nd Street, New York 17, N. Y.

LABELED AND PACKAGED FOR YOUR CONVENIENCE

HIGH QUALITY, DEPENDABLE—



Pitch	Roller Width	Chain No.
3/8"	3/16"	DIAMOND No. 82 AM. STD. No. 35
1/2"	1/4"	DIAMOND No. 41 AM. STD. No. 41
1/2"	5/16"	DIAMOND No. 60 AM. STD. No. 40
5/8"	3/8"	DIAMOND No. 649 AM. STD. No. 50
3/4"	1/2"	DIAMOND No. 422 AM. STD. No. 60
1"	5/8"	DIAMOND No. 424 AM. STD. No. 80

DIAMOND ROLLER CHAINS AND SPROCKETS

The constantly increasing use of Diamond Roller Chain for power transfer has made possible the wider range of Finished-Bore Sprockets which with the Taper-Lock replaceable bushing type Sprockets for the large bores, provide stock drives to meet the vast majority of requirements.

RE-WORKING ELIMINATED

Since Diamond Finished-Bore Sprockets are complete with keyways and setscrews and are available from stock in 75 tooth sizes with more than 280 accurately finished bores—the job of re-working as required by conventional minimum bore sprockets is eliminated.

QUICKER SERVICE AND DELIVERY

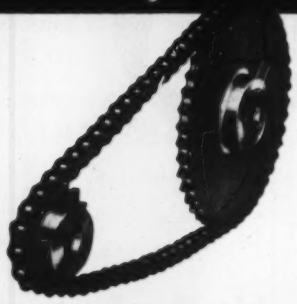
This combination of packaged Diamond Roller Chains in American Standard sizes, wide range of solid sprockets and the Taper-Lock replaceable bushed sprockets, provide for quick delivery from distributors. New Catalog 753 gives all details.

DIAMOND CHAIN COMPANY, Inc.
Where High Quality is Traditional
Dept. 413, 402 Kentucky Avenue, Indianapolis 7, Indiana
Offices and Distributors in All Principal Cities

See the yellow pages of your classified telephone directory for the address of the Diamond Chain distributor

DIAMOND ROLLER CHAINS

Write for latest literature



What shape is a quality fastener?

Here is a handful of ELASTIC STOP® nuts. Each has ESNA's familiar red locking collar . . . is self-locking and vibration-proof. Each is a readily assembled, one-piece unit. Each provides positive protection against thread corrosion . . . prevents liquid seepage along bolts. Each is made from the finest of raw materials. Each is exactly controlled as to finished dimensions, class of thread fit and finish. Each is now in use on critical applications, with a record for uniform high quality that is unmatched.

Most of them are standard parts. Some originated as the result of a specific request for ESNA's help with an important fastening problem.

Isn't it logical to call on us with your next fastening problem?

ELASTIC STOP NUT CORPORATION OF AMERICA

ESNA TRADE MARK

ROLLPIN TRADEMARK

Elastic Stop Nut Corporation of America
Dept. N62-69, 2330 Vauxhall Road, Union, N. J.

Please send the following free fastening information:

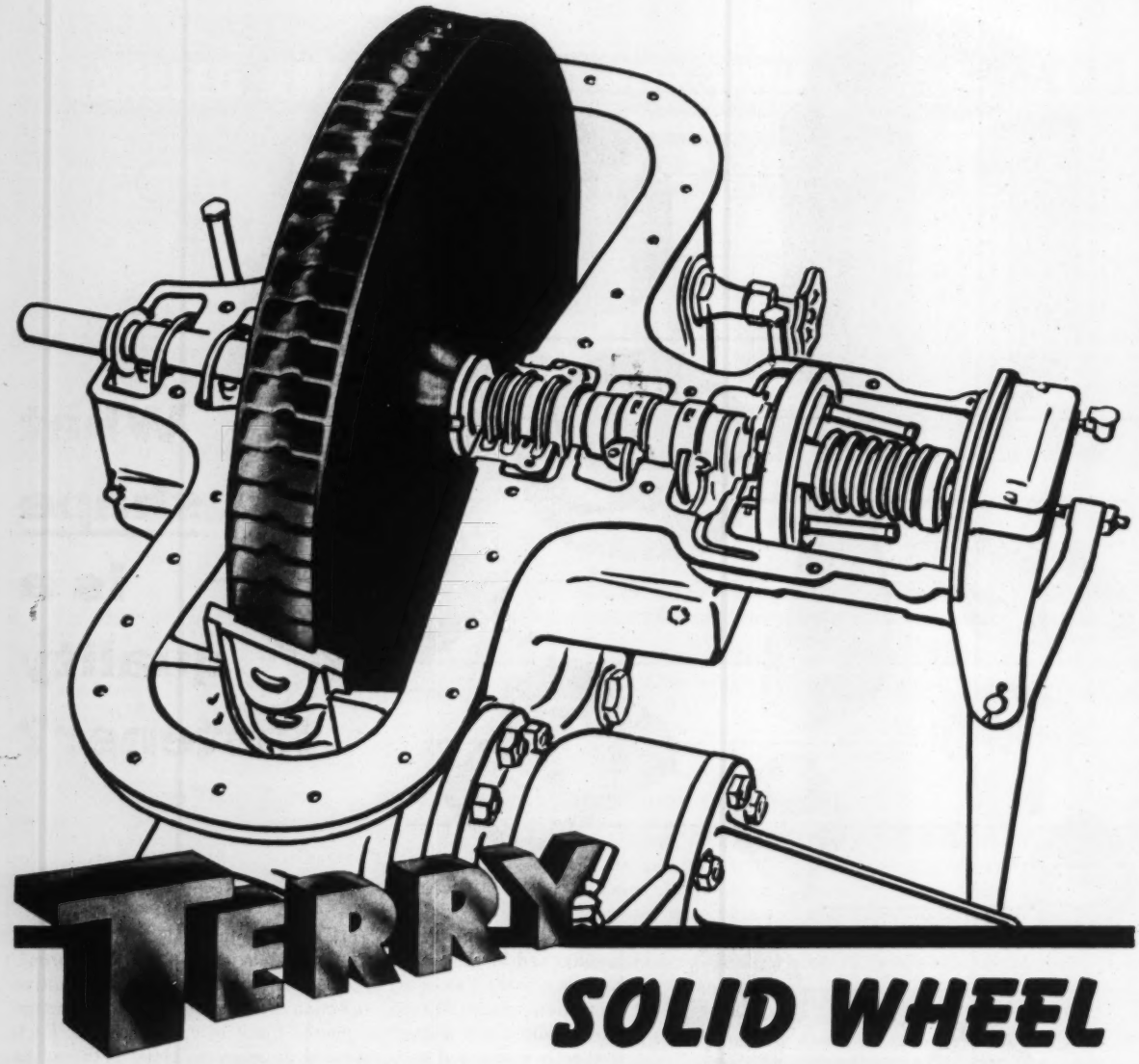
☐ ELASTIC STOP nut bulletin ☐ Here is a drawing of our product. What self-locking fastener would you suggest?

Name_____ Title_____

Firm_____

Street_____

City_____ Zone_____ State_____



SOLID WHEEL RUGGEDNESS

is your turbine dividend

The rugged construction and fool-proof design of a Terry solid-wheel turbine can save you money by keeping maintenance costs to a minimum. Usually only taken down for routine inspection, any repairs that must be made are of relatively simple nature, and cost of replacement parts is small.

The rotor of the turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

It is impossible for the blades to foul. They have large clearances and are further protected by the projecting rims of the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry solid-wheel turbine is an extremely reliable piece of equipment—why not write for complete details today? Ask for a copy of Bulletin S-116.

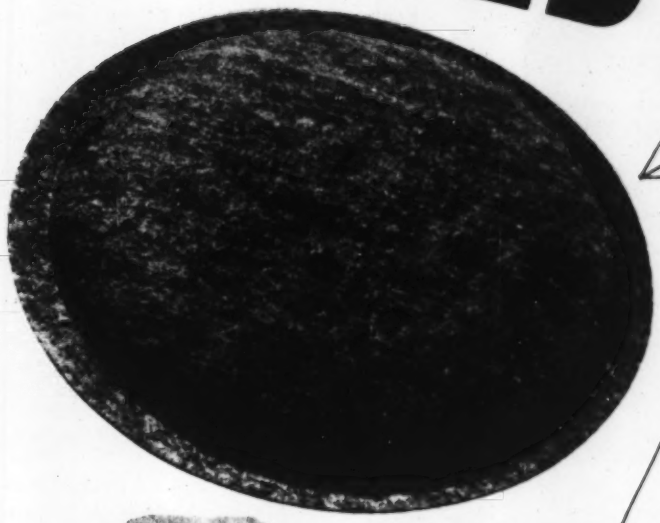
TT-1198

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

SCIENCE MAKES POSSIBLE

FUSED EDGES

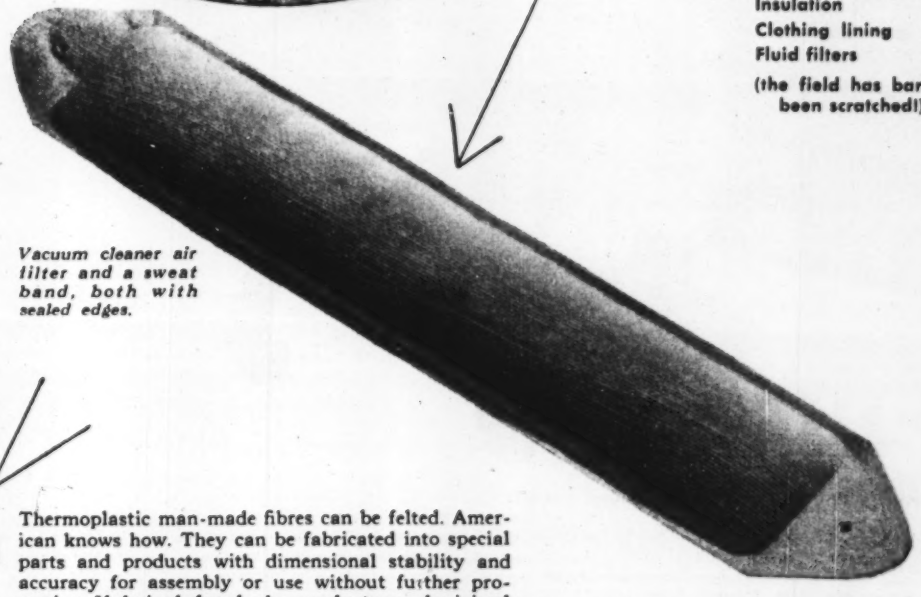
U.S. Pats. 2561,282 1951



Some Present Uses

Dust shields
Vacuum cleaner filters
Powdered soap containers
Face powder pads
Insulation
Clothing lining
Fluid filters

(the field has barely been scratched!)



Vacuum cleaner air filter and a sweat band, both with sealed edges.

Thermoplastic man-made fibres can be felted. American knows how. They can be fabricated into special parts and products with dimensional stability and accuracy for assembly or use without further processing. If desired, fused edge products can be joined to other fabrics instead of by the conventional methods of stitching, adhesives or clamping. The felt within the edges can have any desired porosity, or density characteristics, within wide limits, since such felts can be made entirely of manufactured fibres, or contain mixtures of natural and man-made fibres. Thus these fused-edge felts have great versatility, and are capable of rendering many different services. It will pay you to look into what fused-edge felt products and parts can do for you. Write for information on your company letterhead.

American Felt Company

TRADE MARK

50 GLENVILLE RD. GLENVILLE, CONN.

"then the dragon came..."

Nobody tells a story like Daddy. The everyday world fades away as his words lead you into a new and shining land.

And what if the Dragon is a bit scary? You need only climb into Daddy's arms to be safe and secure again before it's time to sleep.

To make those we love safe and secure is the very core of homemaking. It is a privilege known only in a country such as ours, where men and women are free to work for it.

And taking care of our own is also the way we best take care of our country. For the strength of America is simply the strength of one secure home touching that of another.

Saving for security is easy! Read every word—now!

If you've tried to save and failed, chances are it was because you didn't have a *plan*. Well, here's a savings system that really works—the Payroll Savings Plan for investing in U.S. Savings Bonds. This is all you do. Go to your company's pay office, choose the amount you want to save—a couple of dollars a payday, or as much as you wish. That money will be set aside for you before you even draw your pay. And automatically invested in Series "E" U.S. Savings Bonds which are turned over to you.

If you can save only $3.75 a week on the Plan, in 9 years and 8 months you will have $2,137.30.

United States Series "E" Savings Bonds earn interest at an average of 3% per year, compounded semiannually, when held to maturity! And they can go on earning interest for as long as 19 years and 8 months if you wish, giving you a return of 80% on your original investment!

Eight million working men and women are building their security with the Payroll Savings Plan. For your sake, and your family's, too, how about signing up today? If you are self-employed, ask your banker about the Bond-A-Month Plan.

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How to INCREASE BOILER RATINGS with your present furnace and stack

Coppus-Dennis FANMIX Burners Give You More Heat with No Other Major Change in Equipment

Coppus-Dennis **FANMIX** Burners give you *perfect* mechanical mixing of fuel and air *at the burner outlet . . . instantaneous* ignition close to the burner . . . and *complete* combustion *without visible flame* when burning natural gas. No other burner combines these three advantages.

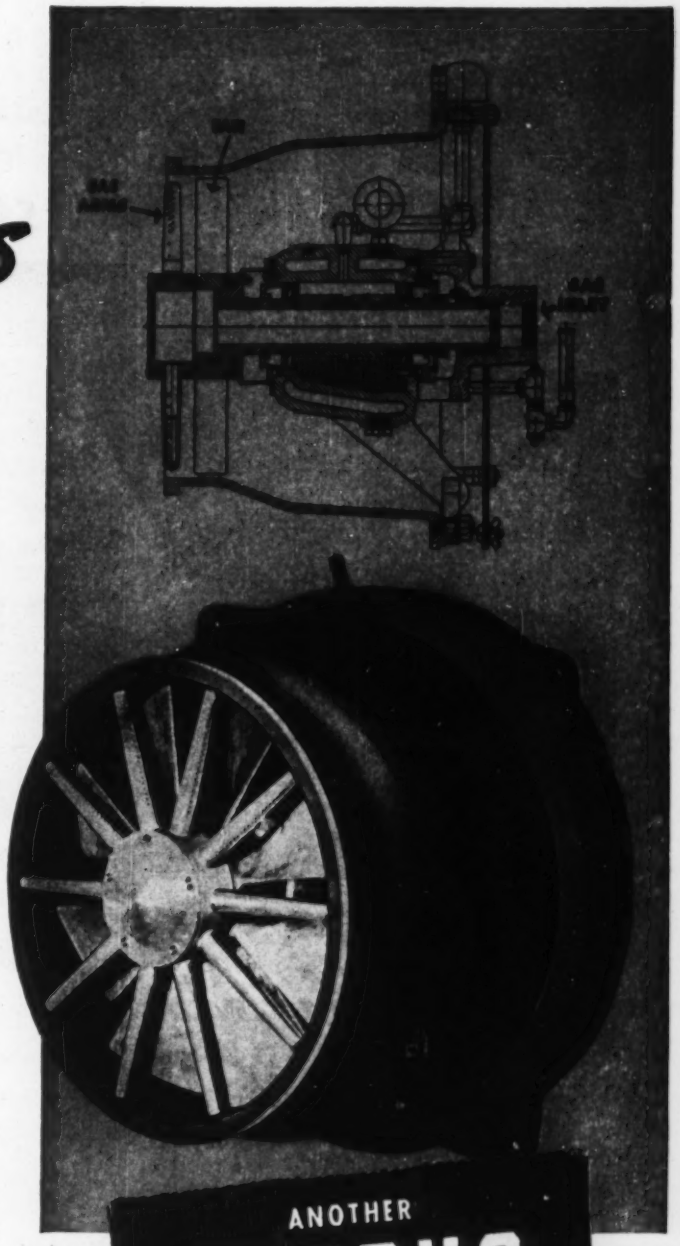
Because **FANMIX** delivers the *right* mixture of fuel and air *without blow-torch action*, all of your furnace space is used for combustion . . . *none for mixing*. That's why your present furnace can release more heat . . . why new installations can get more heat out of smaller furnace space.

Because **FANMIX** can be guaranteed to secure complete combustion of natural gas *with less than 5% excess air*, you get uniform "radiant heat" *without drifting hot spots*. That's why a **FANMIX**-fired furnace seldom varies in temperature more than 5% over its entire area.

WRITE FOR ALL THE FACTS

When you see in Bulletin 410–6 how fuel escaping from orifices in rotating driver arms rotates the fan to draw the correct proportion of air into the path of the fuel at right angles . . . how **FANMIX** creates its own forced draft, reduces stack requirements, prevents cracking of "wet" gas . . . how two **FANMIX** types handle either gas or oil or any combination of both — you'll understand why **FANMIX** Burners have such wide acceptance in oil refineries and power plants.

Send for the Coppus-Dennis **FANMIX** Bulletin 410–6. Coppus Engineering Corporation, Worcester 2, Mass. Sales Offices in THOMAS' REGISTER. Other Coppus "Blue Ribbon" products in BEST'S SAFETY DIRECTORY, CHEMICAL ENGINEERING CATALOG, and REFINERY CATALOG.



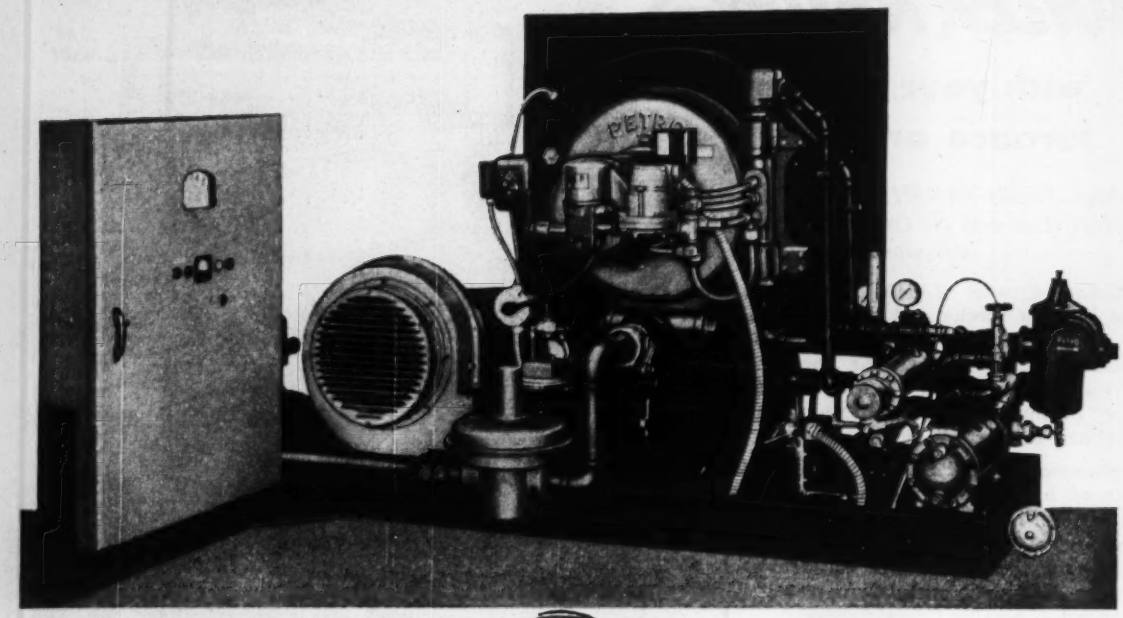
ANOTHER
COPPUS
"BLUE RIBBON" PRODUCT

COPPUS ENGINEERING CORP.
[illegible] Park Ave., Worcester 2, Mass.
Please send Bulletin 410–6 to:

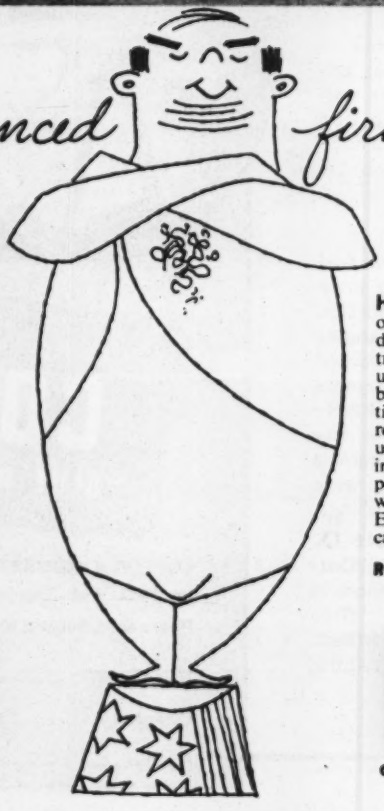
Name _____
Company _____
Address _____

Petro

COMPLETE PACKAGED UNIT OIL, GAS, OR OIL-GAS COMBINATION BURNERS



a perfectly-balanced firing system...



FOR OIL...

Burns any weight oil with complete dependability. Consists of heavy duty Petro horizontal rotary oil burner with steel windbox, refractory tile burner throat, secondary air volume control, motor-driven forced draft fan, and electrical control panel, all mounted on a rugged structural steel base, factory-wired and tested.

FOR GAS...

High combustion efficiency is obtained from all types of fuel gas with this ring-type forced draft burner. Fully modulating automatic controls supply fuel and air in exact proportions required to meet load demands, with excellent fuel economy. Combustion constantly monitored by electronic controls.

FOR BOTH...

Two complete burners—one for oil, one for gas—function independently. Fuels can be switched in a matter of seconds without loss of steam pressure, water temperature, or interruption of production. Gives alternate stand-by fuel and permits taking advantage of fuel price fluctuations. Write Petro, 3038 W. 106th Street, Cleveland 11, Ohio. In Canada: 2231 Bloor St. West, Toronto, Ontario.

in ONE factory-assembled and tested unit

HERE THEY ARE—all the essential components of a modern firing system . . . burner, forced draft fan, air volume control, and enclosed electrical control panel in *one* complete packaged unit. It provides a sure way to modernize any boiler room for dependable, economical operation. Engineered to fit specific boiler and fuel requirements, it is installed as an integral working unit. Fully modulating controls follow variations in load demands. Forced draft system gives peak performance from the moment the burner starts, without dependance on high stack for draft. Exceptionally quiet operation. Write for specification sheets and full details.

Residential Oil and Gas Burners, Oil and Gas Furnaces and Boilers, Industrial and Commercial Oil, Gas and Oil-Gas combination Burners

PETRO

T. M. REG. U. S. PAT. OFF.

OVER 50 YEARS OF LEADERSHIP IN AUTOMATIC HEATING AND POWER EQUIPMENT

Helping fill America's cookie jar

115 LINK-BELT screw conveyors and feeders at Nabisco handle flour and sugar for half a million pounds of crackers and cookies daily

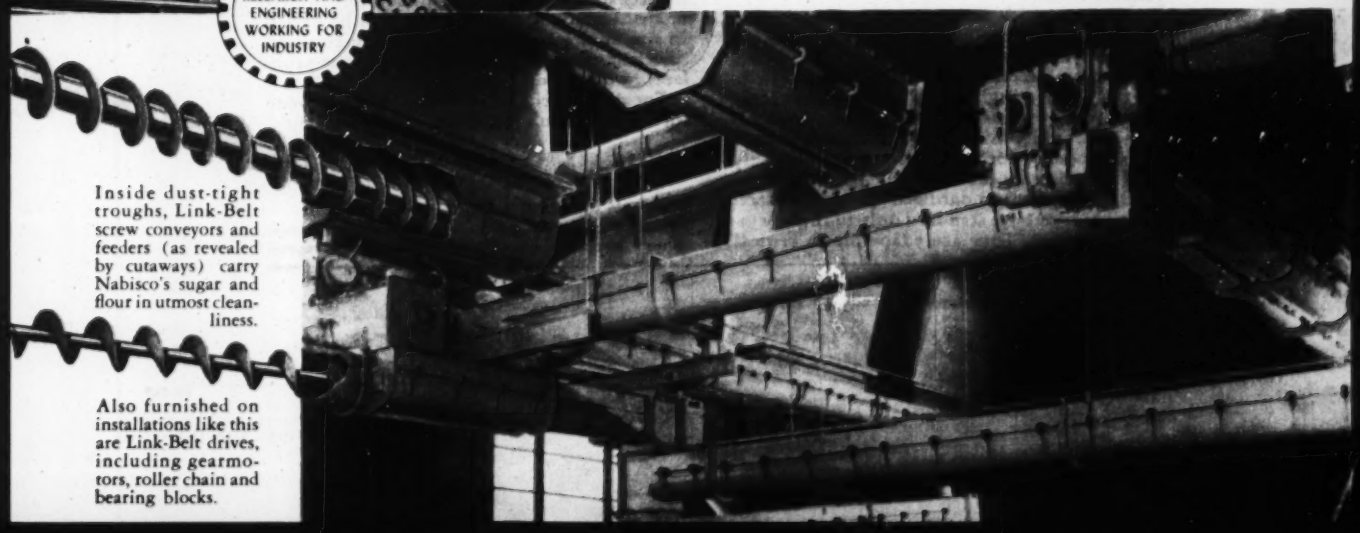
AT National Biscuit Company's new Chicago bakery, they use flour and sugar by the carload. The tasks of moving the sugar and four types of flour from storage bins to mixers and blending them in proper proportions are performed by a system of 115 Link-Belt screw feeders and conveyors.

Safe, sanitary and efficient—the complete Link-Belt system is operated by pushbuttons. From a central control panel, the operator can draw exactly the desired amount from any of the 93 bins.

And food is just one of the basic industries served by Link-Belt. Whatever you're handling—cookies or coal . . . cotton or chemicals—Link-Belt offers a single source of unequalled facilities, equipment and experience. Whether your problem is simple or complex, call the Link-Belt office near you for complete engineering co-operation.

LINK-BELT

One source . . . one responsibility for materials handling and power transmission machinery



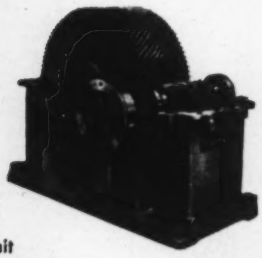
Inside dust-tight troughs, Link-Belt screw conveyors and feeders (as revealed by cutaways) carry Nabisco's sugar and flour in utmost cleanliness.

Also furnished on installations like this are Link-Belt drives, including gearmotors, roller chain and bearing blocks.

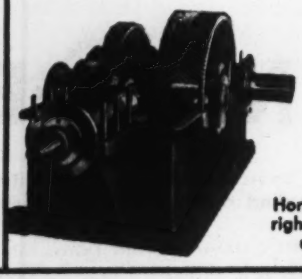
LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.

THE SPEED REDUCER *Most likely to Succeed* IN YOUR PLANT

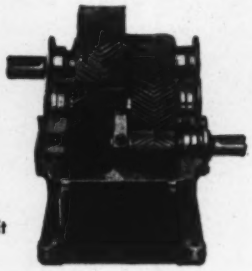
Heavy-duty single reduction unit



Standard single reduction unit



Horizontal right-angle unit



Standard double reduction unit

Farrel speed reducers start out with a better chance in life.

To begin with, the gearing in a Farrel speed reducer has teeth generated by the famous Farrel-Sykes method—a process that assures accuracy of tooth spacing, profile and helix angle. The herringbone design provides evenly distributed pressure over each tooth, from tip to working depth line. This means that there is no tendency for the teeth to wear unevenly and thus shorten the life of the gears.

Unlike most "standardized" products, Farrel speed reducers are standard only in their principal features. They are adaptable in critical detail.

The gears and pinions can be proportioned to meet specific load, speed and service requirements. Input and output shafts can be varied in size, in material and in extension. Housing dimensions can even be changed to meet problems in mounting.

For more about these adaptable units write for a copy of bulletin 449.

FARREL-BIRMINGHAM COMPANY, INC.
ANSONIA, CONN.

Plants: Ansonia & Derby, Conn., Buffalo, N. Y.
Sales Offices: Ansonia, Buffalo, New York, Boston, Akron, Detroit, Chicago, Memphis, Minneapolis, Portland (Oregon), Los Angeles, Salt Lake City, Tulsa, Houston, New Orleans

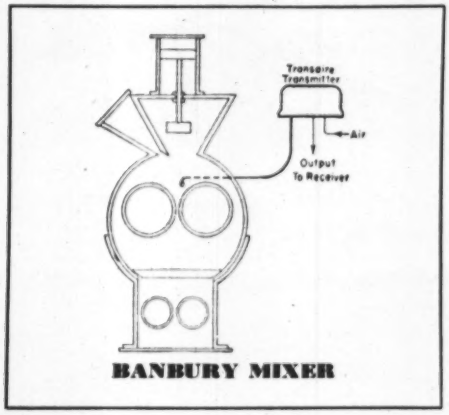
Farrel-Birmingham ®

FB-869

To measure *dynamic temperatures* you need *DYNAMIC ACCURACY!*

DYNAMIC ACCURACY, (the accuracy of an instrument in measuring changing or *dynamic* conditions), reaches a new high in the Taylor TRANSAIRE* Temperature Transmitter. This extreme sensitivity to *changing* conditions is due to the low heat capacity of the cigarette-size bulb and dynamic compensation, i.e., compensation for inherent lags in the measuring system and the rate of heat transfer of the process medium. It is achieved by derivative action (SPEED-ACT) in the measuring circuit. Operates on the force-balance principle. No special calibration of receivers is necessary, thanks to standard output pressure range of 3-15 psi. Write for **Bulletin 98097,** Taylor Instrument Companies, Rochester, N.Y., or Toronto, Canada.

HERE ARE THREE TOUGH MEASUREMENT PROBLEMS SOLVED BY DYNAMIC ACCURACY



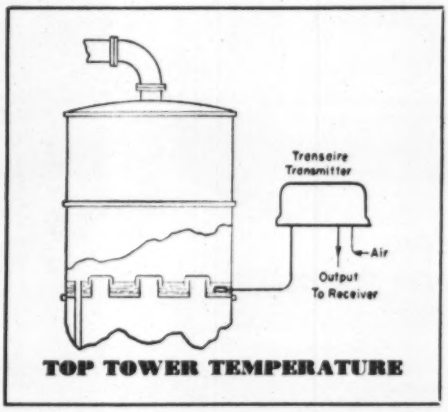
BANBURY MIXER

Compensates for Poor Heat Transfer of Mix

Problem: Poor heat transfer of the rubber compounds in a Banbury Mixer makes it difficult to closely measure the mechanical heat generated. Excessive heat causes deterioration of ingredients—and a very real fire hazard.

Solution: TRANSAIRE Temperature Transmitter, with derivative action (SPEED-ACT) in the measuring system, compensates for both the poor heat conductivity of the mix and the inherent thermal lag of the rugged separable well required. The cigarette-size bulb permits its ideal location, and aids the speed of response, as of course does the THERMOSPEED sleeve in the separable well.

Results: An accurate record of the true *dynamic temperatures* of the mix and the *time* of every batch. Another dividend: the process can now be put under automatic control — never before feasible.



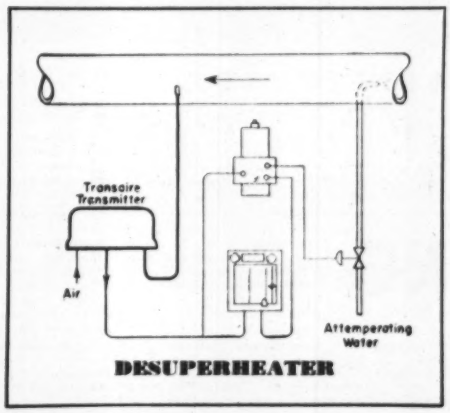
TOP TOWER TEMPERATURE

Short Range Span Detects Temperature Trends

Problem: To get highest possible purity of product consistent with good production economy. This requires the quick detection of temperature trends over a very narrow range.

Solution: The short, shiftable range spans (as short as 50°F.) for the TRANSAIRE Temperature Transmitter permit selection of operating range by a simple screwdriver adjustment. SPEED-ACT feature assures detection of temperature change of less than 1/10 of 1% of span and is accurate to ½% of span.

Results: Close control because the minute temperature trends are practically instantaneously detected and transmitted to the controller and receiver. This means higher yield of a purer product, also great flexibility in changing to different product requirements.



DESUPERHEATER

Fast Speed of Response Catches Rapid Temperature Changes

Problem: Steam at high temperature, as with any gas temperature measuring problem, has poor heat transfer characteristics, making it difficult to measure dynamic temperatures.

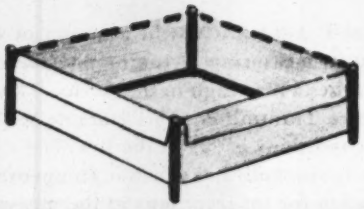
Solution: The low heat capacity of the cigarette-size bulb (made possible by the force-balance system), and SPEED-ACT compensation for the rugged well required, give unprecedented speed of response to temperature changes under these adverse conditions.

Results: Smooth efficient operation, and greater protection to expensive equipment in subsequent processing steps.

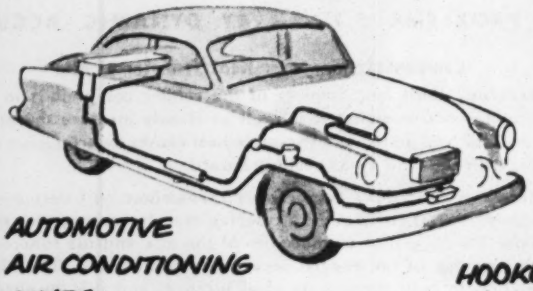
*Reg. U.S. Pat. Off.

TAYLOR INSTRUMENTS MEAN ACCURACY FIRST

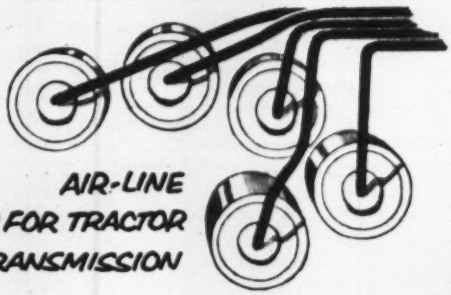
FROM *the Bundy Sketchbook*
TO *jog a designer's imagination*



FRAME FOR DOG-AND-CAT BED



AUTOMOTIVE AIR CONDITIONING LINES

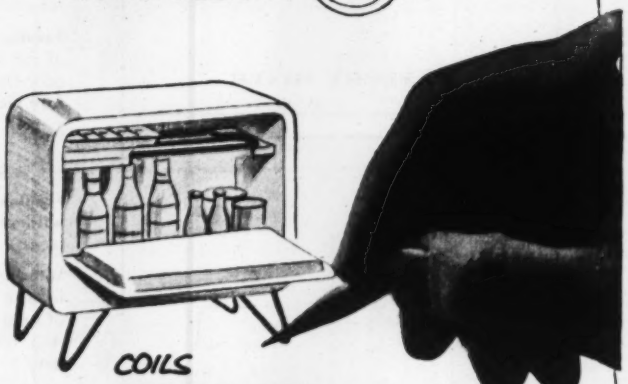


AIR-LINE HOOKUP FOR TRACTOR TRANSMISSION

REMARKS Maybe you demand tubing versatility above all else. Or maybe durability is more important to your product. Whatever your fabrication or performance requirements, you can rely on Bundyweld, the only tubing double-walled from a single strip. Added bonus: Bundy's expert engineering services, unexcelled fabrication facilities.

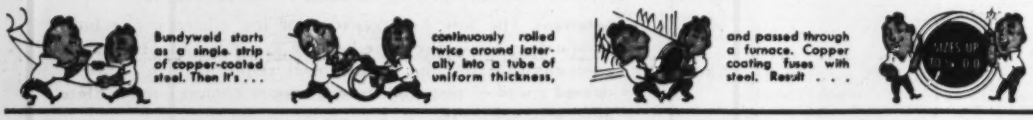
WRITE today for information or for help in developing your tubing ideas.

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN



COILS FOR PORTABLE REFRIGERATORS

WHY BUNDYWELD IS BETTER TUBING



Bundyweld starts as a single strip of copper-coated steel. Then it's . . . continuously rolled twice around laterally into a tube of uniform thickness, and passed through a furnace. Copper coating fuses with steel. Result . . . Bundyweld, double-walled and brazed through 360° of wall contact.

BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting point
High endurance limit
Extra-strong
Shock-resistant
Ductile
Lightweight
Machines easily
Takes plastic coating
Takes plating
Bright and clean
No inside bead
Uniform I.D., O.D.

Bundy Tubing Distributors and Representatives: *Bridgeport, Conn.:* Korhumel Steel & Aluminum Co., 117 E. Washington St. • *Cambridge 42, Mass.:* Austin-Hastings Co., Inc., 226 Binney St. *Chattanooga 2, Tenn.:* Poirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • *Chicago 32, Ill.:* Lapham-Hickey Co., 3333 W. 47th Place • *Elizabeth, New Jersey:* A. B. Murray Co., Inc., Post Office Box 476 • *Los Angeles 58, Calif.,* Tubesales, 5400 Alcoa Ave. • *Philadelphia 2, Penn.:* Rutan & Co., 1717 Sansom St. • *San Francisco 10, Calif.:* Pacific Metals Co., Ltd., 3100 19th St. • *Seattle 4, Wash.:* Eagle Metals Co., 4755 First Ave., South • *Toronto 5, Ontario, Canada:* Alloy Metal Sales, Ltd., 181 Fleet St., W.
Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.

GIDDINGS & LEWIS — ALLEN-BRADLEY CONTROL PANEL

KEARNEY & TRECKER — ALLEN-BRADLEY CONTROL PANEL

MICROMATIC HONE — ALLEN-BRADLEY CONTROL PANEL

LEES-BRADNER — ALLEN-BRADLEY CONTROL PANEL

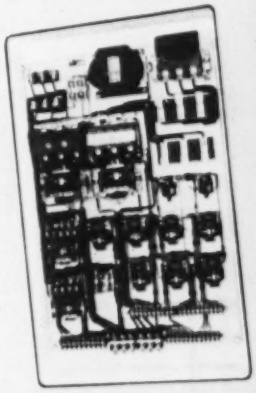
FELLOWS — ALLEN-BRADLEY CONTROL PANEL

CROSS — ALLEN-BRADLEY CONTROL PANEL

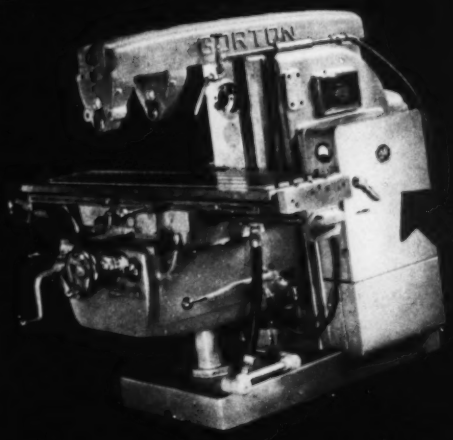
LE BLOND — ALLEN-BRADLEY CONTROL PANEL

This LeBlond lathe has an Allen-Bradley control panel in cabinet at end of lathe. There are 20 components of which 14 are Allen-Bradley relays, contactors, and starters.

Allen-Bradley solenoid controls have ONLY ONE MOVING PART. No pins, pivots, or bearings to rust and stick. They are good for millions of trouble-free operations. That's why A-B controls are a sales asset to any machine tool.

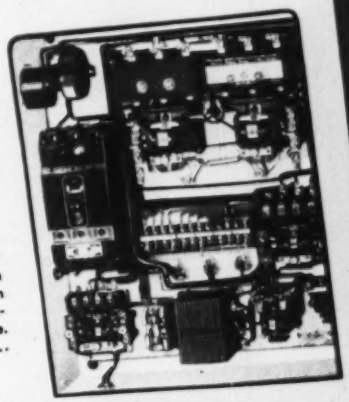


GORTON — ALLEN-BRADLEY CONTROL PANEL



This Gorton milling machine has an Allen-Bradley sequence control panel in the machine frame with 6 A-B solenoid-operated relays and starters, all equipped with silver alloy contacts that require no maintenance.

The ITE circuit breaker is interlocked with the door handle, which must be in OFF position to open cabinet. This is an important safety feature. Specify Allen-Bradley... and be safe.



ENGINEERED TO FIT YOUR NEEDS

Machine tool panels, designed and built by Allen-Bradley, provide dependable, automatic sequence control of machining operations . . . with split-second accuracy. Allen-Bradley control panels are all tailor-made to get the greatest output from machine tools of every type. Your near-by Allen-Bradley sales engineer will gladly discuss your control requirements.

Send for Bulletin
ALLEN-BRADLEY CO.
1316 S. Second St., Milwaukee 4, Wis.

3-54-R

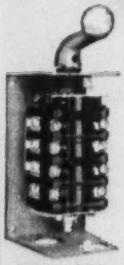
ALLEN-BRADLEY

MOTOR CONTROL

QUALITY COMPONENTS

FOR MACHINE TOOL CONTROL PANELS

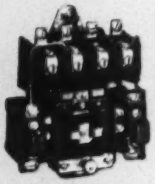
A-B Quality



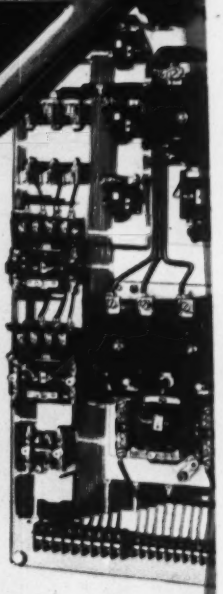
Bulletin 350 Drum Switch

Bulletin 600 Small Motor Starter

Bulletin 609 Manual Starter



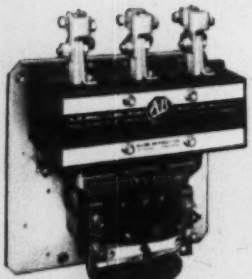
Bulletin 709 Automatic Motor Starter



All components of Allen
like relays, contactors, st
or terminal strips, are
the A-B line. But whil
tested in thousands of
continuously tested d
how A-B control maintains its reputation for
Quality. Specify Allen-Bradley.

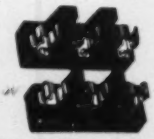
Allen-Bradley Co., 1316 S. Second St.
Milwaukee 4, Wisconsin

WA
PAG



Bulletin 702 Solenoid Contactor

Bulletin 800T Oiltight Push Buttons

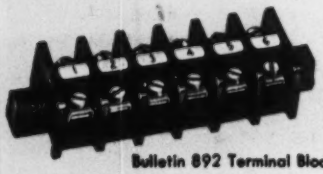


Bulletin 891 Fuse Clips

Bulletin 802T Limit Switch

Bulletin 849 Pneumatic Timer

Bulletin 895 Auxiliary Contacts



Bulletin 892 Terminal Blocks

ALLEN-BRADLEY

TROUBLE-FREE MOTOR CONTROLS

3-54-R

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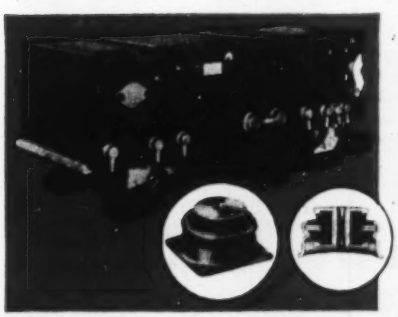
. . . anywhere!

oducts and reduce their maintenance cost may control of destructive vibration and shock. To ord Engineering recommends the correct design, tal, and uses precision manufacturing for all Rubber Parts. Your vibration and shock control our business. We welcome the opportunity of placing our wide experience in many diversified industries at your disposal.

Over 27,000 designs and their variations from which to choose.



The sensitivity of many commercial and military radio transmitters is protected . . . their accuracy is insured against vibration and shock damage by Lord Vibration Control Mountings. Ask for complete details.

LOS ANGELES 28, CALIFORNIA 7046 Hollywood Blvd. **DALLAS, TEXAS** 313 Fidelity Union Life Building **PHILADELPHIA 7, PENNSYLVANIA** 725 Widener Building **DAYTON 2, OHIO** 410 West First Street
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LORD MANUFACTURING COMPANY • ERIE, PA.

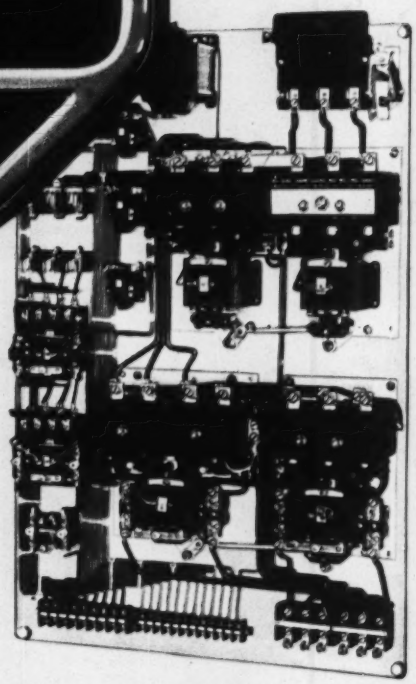
LORD — BONDED RUBBER

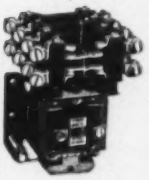
Headquarters for
VIBRATION CONTROL
FOR 20 YEARS

QUALITY COMPONENTS

FOR MACHINE TOOL CONTROL PANELS

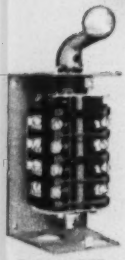
A-B Quality





Bulletin 700 Universal A-C Relays

Bulletin 200 D-C Relays

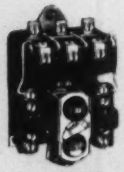


Bulletin 350 Drum Switch

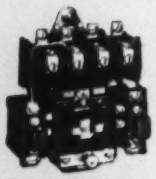
Bulletin 600 Small Motor Starter

Bulletin 713 Starter and Cir. Breaker

Bulletin 712 Starter and Disc. Switch



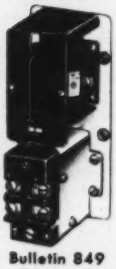
Bulletin 609 Manual Starter



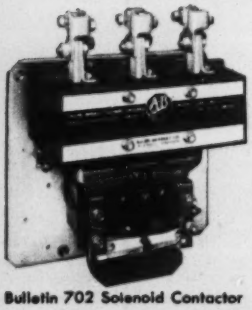
Bulletin 709 Automatic Motor Starter

All components of Allen-Bradley control panels, like relays, contactors, starters, timers, fuse clips, or terminal strips, are long-established units in the A-B line. But while they have been field-tested in thousands of applications, they still are continuously tested during manufacture. That's how A-B control maintains its reputation for Quality. Specify Allen-Bradley.

Allen-Bradley Co., 1316 S. Second St.
Milwaukee 4, Wisconsin



Bulletin 849 Pneumatic Timer



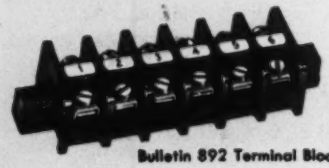
Bulletin 702 Solenoid Contactor

Bulletin 800T Oiltight Push Buttons

Bulletin 891 Fuse Clips

Bulletin 802T Limit Switch

Bulletin 895 Auxiliary Contacts



Bulletin 892 Terminal Blocks

ALLEN-BRADLEY

TROUBLE-FREE MOTOR CONTROLS

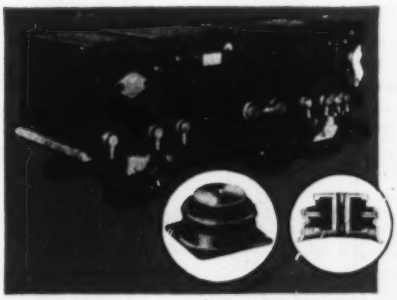
3-54-R

JUST A MATTER OF CONTROL

LORD ENGINEERING CONTROLS VIBRATION ... anywhere!

Your continuing effort to improve your products and reduce their maintenance cost may be entirely A Matter Of Control . . . the control of destructive vibration and shock. To help you to accomplish your objectives, Lord Engineering recommends the correct design, selects the most suitable elastomer and metal, and uses precision manufacturing for all Vibration Control Mountings and Bonded Rubber Parts. Your vibration and shock control problems are our business. We welcome the opportunity of placing our wide experience in many diversified industries at your disposal.

Over 27,000 designs and their variations from which to choose.



The sensitivity of many commercial and military radio transmitters is protected . . . their accuracy is insured against vibration and shock damage by Lord Vibration Control Mountings. Ask for complete details.

LOS ANGELES 28, CALIFORNIA 7046 Hollywood Blvd.
DALLAS, TEXAS 313 Fidelity Union Life Building
PHILADELPHIA 7, PENNSYLVANIA 725 Widener Building
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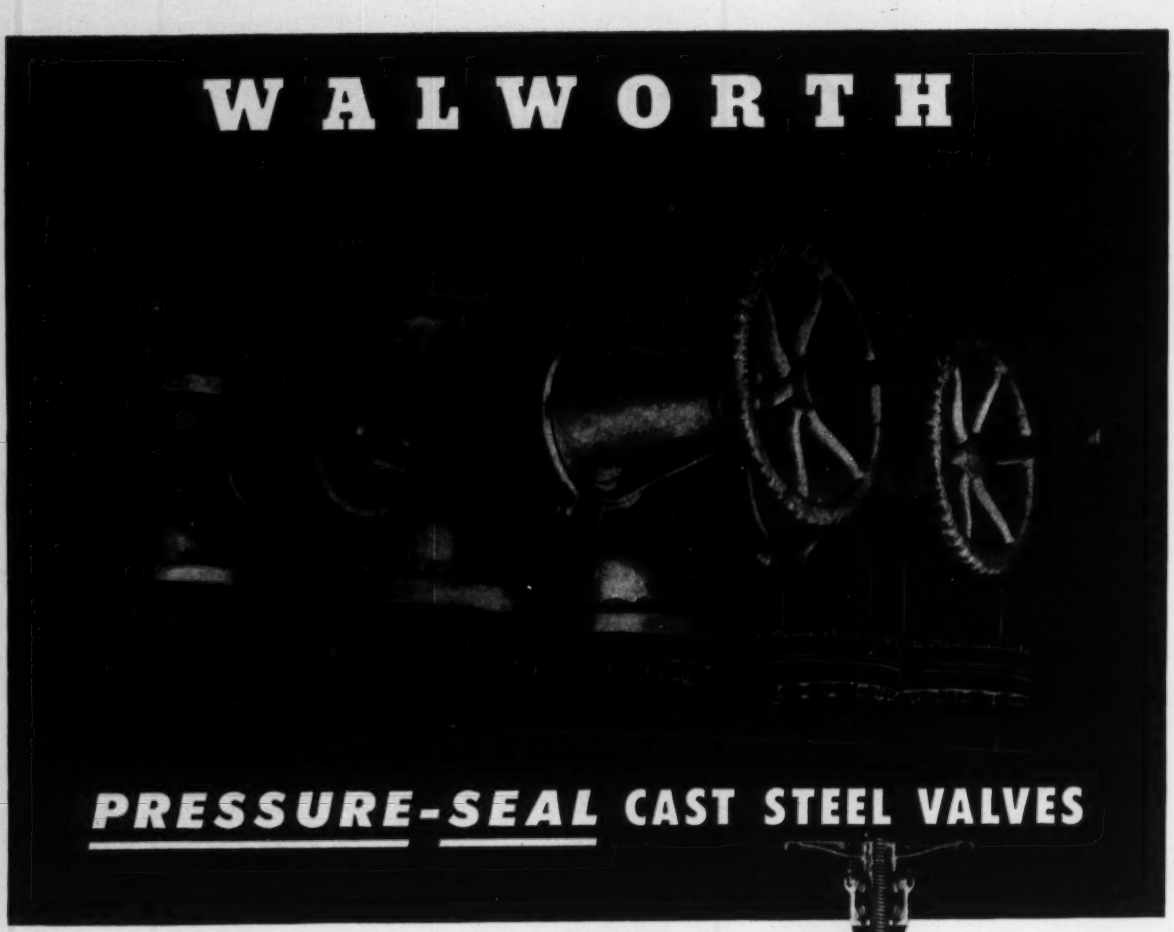
LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

Headquarters for **VIBRATION CONTROL** FOR 38 YEARS

WALWORTH

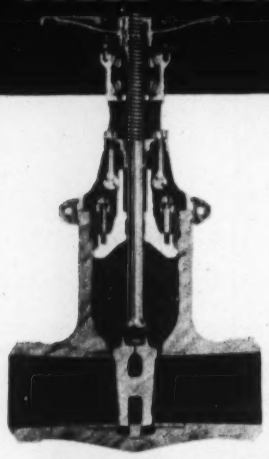


PRESSURE-SEAL CAST STEEL VALVES

Better because ... **They have no bonnet flanges, bonnet bolts, or bonnet welds. Ideal for high-pressure, high-temperature steam service and corresponding boiler feed service, Walworth Pressure-Seal Cast Steel Valves weigh less, and take up less space than the flanged bonnet type of valves used for similar services.**

These are a few of the important advantages made possible by the design of Walworth *Pressure-Seal* Cast Steel Valves. Internal line pressure is utilized within the bonnet to maintain a tight, leakproof, body-to-bonnet connection under all normal operating conditions. The higher the pressure, the tighter the seal.

Ask for your copy of Walworth Circular 143. It gives detailed information, including sizes, dimensions, and specifications for all Walworth Pressure-Seal Cast Steel Valves.



Cross section of 8-inch Series 900 Walworth Pressure-Seal Cast Steel Gate Valve. Pressure-Seal Globe, Check, Angle, and Non-Return Valves are also available in Series 600, 900, 1500 and 2500 in a wide range of sizes.

WALWORTH

Manufacturers since 1842

valves . . . pipe fittings . . . pipe wrenches

60 East 42nd Street, New York 17, N. Y.

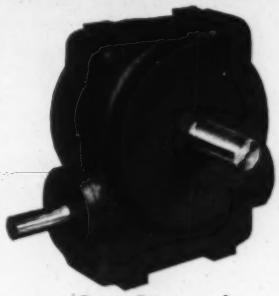
DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

D.O.James

TYPE "S" WORM GEAR SPEED REDUCERS

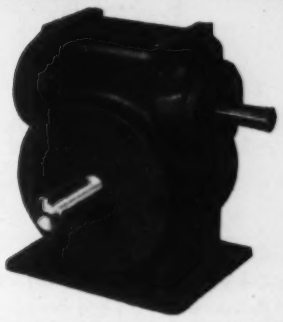
RATIOS FROM 5.66:1 TO 100:1 — .04 HP TO 15.6 HP

Horizontal Type—Worm at Bottom
Sizes 17S, 22S, 26S, 33S

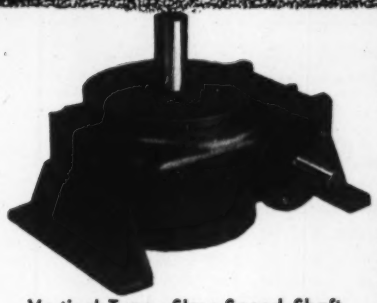


Base Removed

Sizes 17 to 33 inclusive have detachable bases or feet, are adaptable to horizontal or vertical applications, convertible from one to the other, or may be used without bases to suit particular installations.

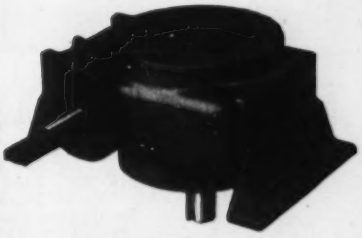


Horizontal Type—Worm at Top
Sizes 17ST, 22ST, 26ST, 33ST



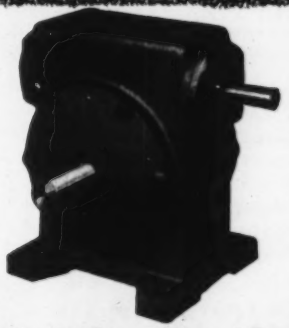
Vertical Type—Slow Speed Shaft Extends Upward
Sizes 17SV, 22SV, 26SV, 33SV

Feet Removed

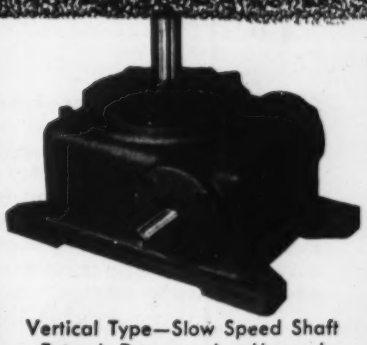


Vertical Type—Slow Speed Shaft Extends Downward
Sizes 17SV, 22SV, 26SV, 33SV

Horizontal Type—Worm at Bottom
Sizes 38S, 42S, 46S, 54S



Horizontal Type—Worm at Top
Sizes 38ST, 42ST, 46ST, 54ST



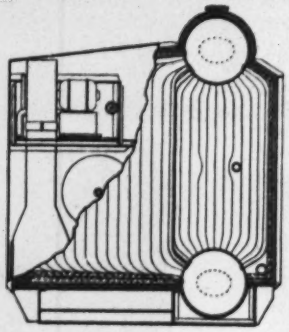
Vertical Type—Slow Speed Shaft Extends Downward or Upward
Sizes 38SV, 42SV, 46SV, 54SV

D.O.JAMES GEAR MANUFACTURING CO.

Since 1888 — Power Saving Equipment for Industry

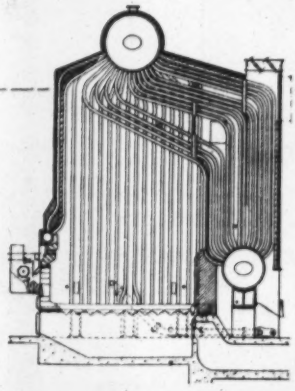
1140 W. MONROE STREET CHICAGO, ILLINOIS

WHICH C-E BOILER MEETS YOUR STEAM NEEDS BEST?

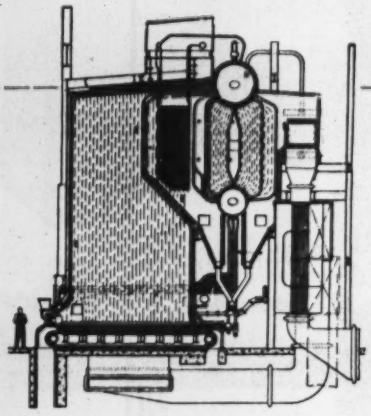


C-E Package Boiler—Type VP—The VP Boiler is designed to meet the demand for compact, standardized units in the medium pressure range. It is shipped completely shop-assembled, with firing equipment, fittings, and forced-draft fan. It is enclosed in a reinforced, welded steel, gas-tight casing. Arranged for pressure firing of oil or gas, the VP will burn either fuel exclusively or alternately. Designed for shipment by rail or truck, its width and height remain constant . . . variations are made in length only. Furnace is fully water-cooled, including burner wall, except in three smallest sizes. Large lower drum permits simple, symmetrical tube arrangement and greater water storage capacity.

Type VP Boiler—from 4,000 to 30,000 lb steam per hr . . . pressure to 250 psi . . . available for either gas or oil firing . . . fully shop-assembled.



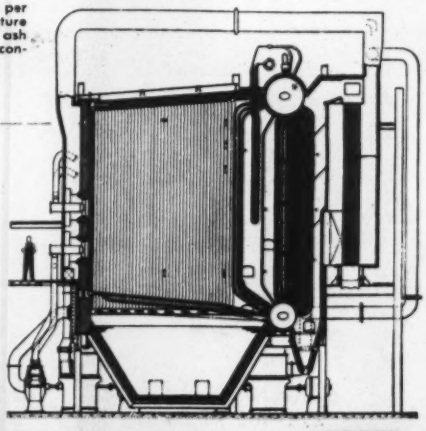
C-E Vertical-Unit Boiler—Type VU-10—Like the Type VP Package Boiler, the VU-10 is designed for plants having a limited number of operating and maintenance personnel. It is designed for industrial load conditions and will operate efficiently over a wide range of output. The boiler is bottom supported and has no outside supporting steel. The same general cross-section arrangement of drums, boiler convection bank, and furnace wall cooling is used when firing oil, gas or coal. Coal firing may be with underfeed, spreader, or chain grate stokers.



Type VU-10 Boiler—from 10,000 to 60,000 lb steam per hr . . . pressure to 475 psi . . . superheat to 200 F . . . suitable for any type of fuel.

C-E Vertical-Unit Boiler—Type VU-40—The VU-40 Boiler is a baffleless boiler designed for use with fuels having abrasive qualities in the flue dust. In a baffled boiler using these abrasive fuels, erosion is apt to occur. In the VU-40 Type Boiler, the eroding action of abrasives against boiler tubes and refractory is virtually eliminated. Like the VU-10 and VU-50, this unit is of symmetrical design, providing uniform gas flow and heat absorption across the full width of the boiler.

Type VU-40 Boiler—from 60,000 lb steam per hr up . . . pressure to 1375 psi . . . temperature to 960 F . . . for use with abrasive or high ash content fuel . . . indoor or outdoor type construction.



C-E Vertical-Unit Boiler—Type VU-50—With the VU-50 Boiler, the average plant can achieve standards of performance closely approaching those of large central power stations. The basic design was originated by Combustion in 1925 and has been widely accepted among steam-power engineers *everywhere*. Because of its symmetrical design the VU-50 provides uniformity of gas flow, water level and steam release across the full width of the unit. It may be fired by pulverized coal as shown opposite or by any other fuel or method of firing. Heat recovery equipment may be added.

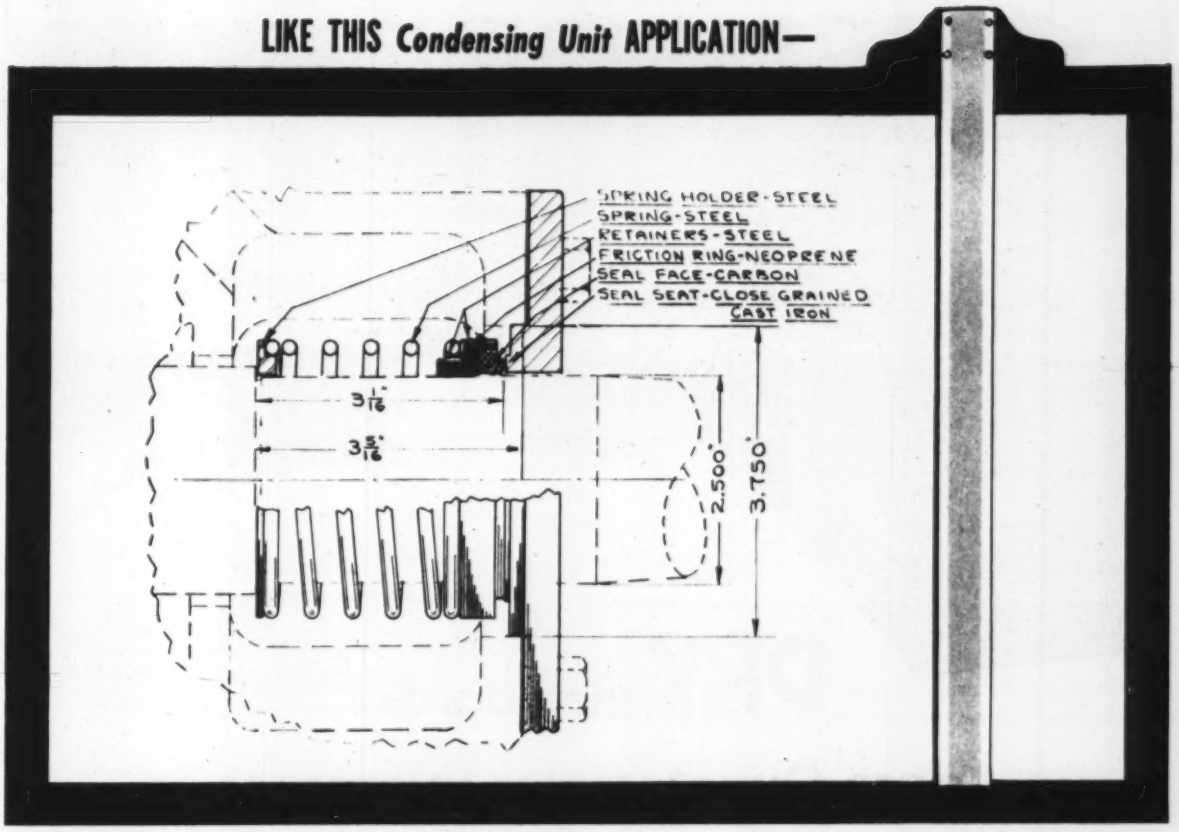
Type VU-50 Boiler—from 60,000 to 350,000 lb steam per hr . . . pressure to 1375 psi . . . temperature to 960 F . . . for any fuel or method of firing . . . indoor or outdoor type construction.

B-703A

C-E

Combustion Engineering Building, 200 Madison Avenue, New York 16, N. Y.

LIKE THIS *Condensing Unit* APPLICATION—



ROTARY SEALS are *Engineered* to meet specific needs!

Condensing units, confronted with extremely rugged operating conditions in all kinds of refrigerating and air conditioning applications, must stand up to them without breakdown or constant maintenance. It takes a *secure* Shaft Seal to assure that kind of continuous, trouble-free compressor operation. That's why so many leading manufacturers in this as in other fields long ago standardized on ROTARY SEALS —because ROTARY SEALS have proved *on the job* that they mean *Shaft Sealing Certainty.*

ROTARY SEALS

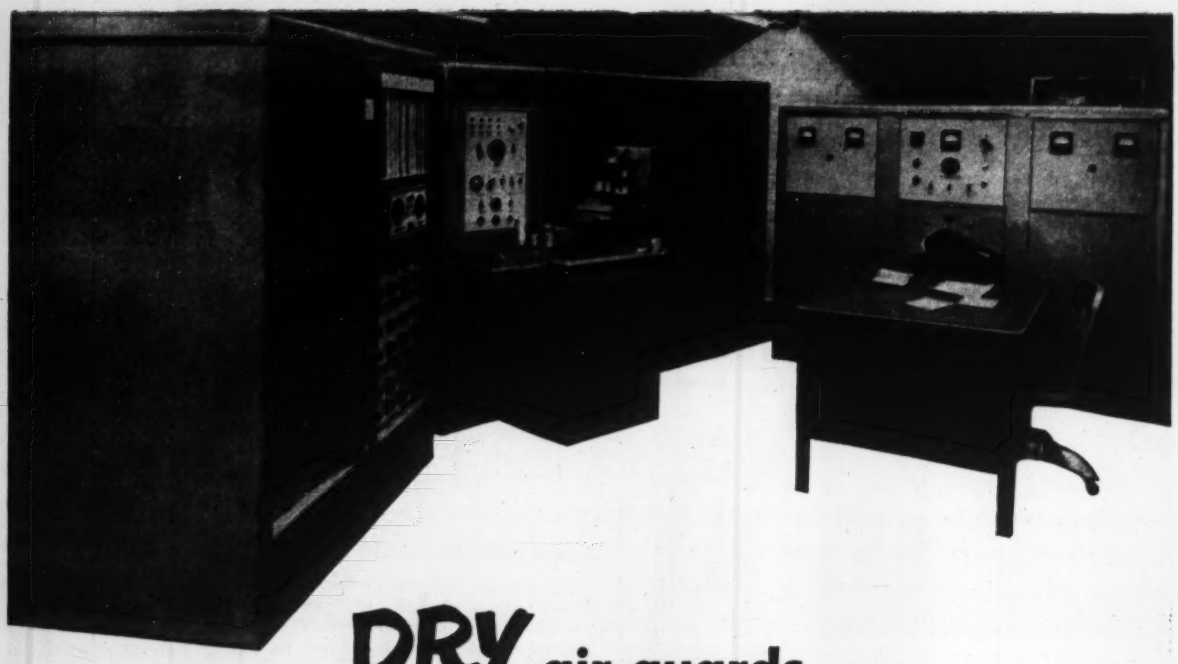
Since no two designs pose precisely the same problems, ROTARY SEALS are tailor-made for each specific case, with just the right adaptation of the famous original ROTARY SEAL patented sealing principle to do the most efficient job possible. This principle is clearly explained and illustrated in our booklet, *"Sealing with Certainty"*, a copy of which is yours for the asking.

Manufacturers in many industries assure the long-run user satisfaction which builds more sales by *Sealing with Certainty* with individually designed Rotary Seals. We believe Rotary Seal engineers can save *you* time and money, too—call them in on the first steps of your product development engineering.

THE mechanical seals for ROTARY SEAL COMPANY rotating shafts

Sealing with Certainty

2024 NORTH LARRABEE STREET
CHICAGO 14, ILLINOIS, U.S.A.



DRY air guards close Quantometer tolerances at Alcoa . . .

Quantometer room at Alcoa's Davenport, Iowa plant. This electronic equipment provides rapid, precise analysis of metals. Accuracy is safeguarded by maintaining a constant relative humidity and temperature in the room.

DATA AVAILABLE — Write for *Because Moisture Isn't Pink*, a booklet that explains the operation and tells how others are using all types of Lectrodryers. Pittsburgh Lectrodryer Corporation, 335 32nd Street, Pittsburgh 30, Pennsylvania.

This quantometer determines the elements in an aluminum alloy in less than a minute. To preserve its accuracy, Alcoa protects the quantometer against variations in temperature and relative humidity. The atmosphere in the room remains fixed day and night at a temperature of 75° F and a relative humidity of 40%. This exact humidity is controlled by a Lectrodryer*.

Perhaps changes in the weather affect a process, equipment or research of yours. If so, a Lectrodryer will permit you to control relative humidity to as low as 10%. Even in large areas, Lectrodryers can maintain dewpoints lower than −100° F. You can DRY air, other gases, and organic liquids in volume to pressures as high as 6000 psi with these machines.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege.

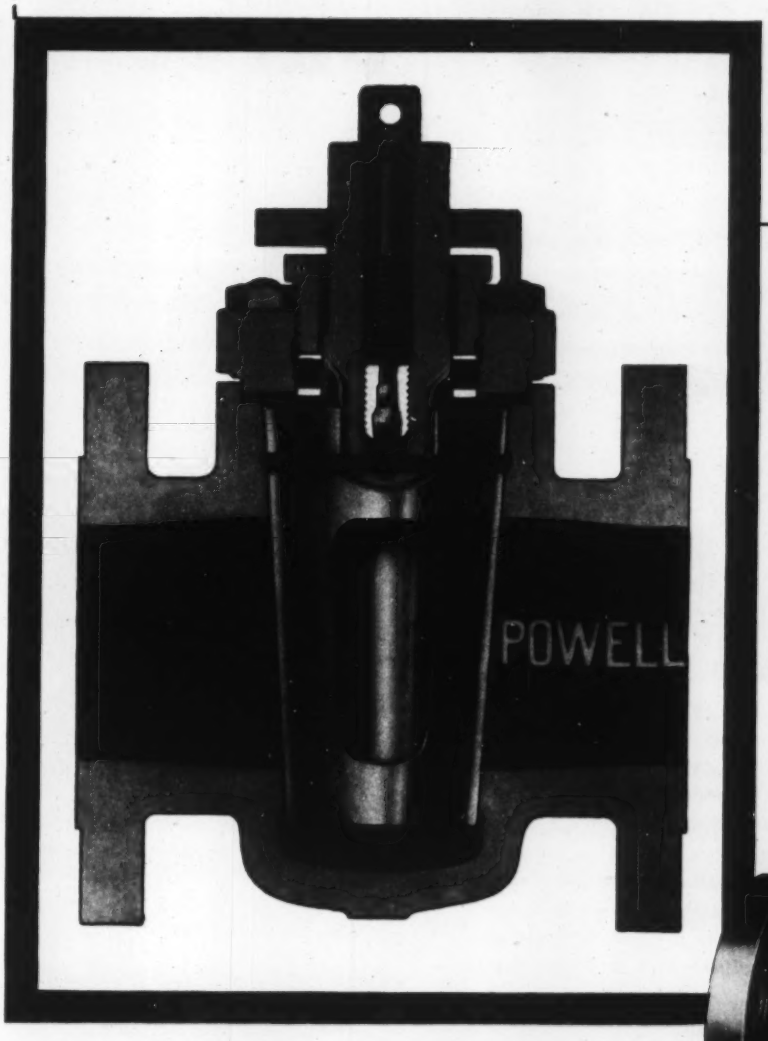
LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.

Powell LUBRICATED PLUG Valves

Now! A great new line of valves that maintain the Powell standards of precision!



Investigate these outstanding new Lubricated Plug Valves that carry the Powell name and measure up to the Powell standards of precision. Features include quick and positive operation – just a quarter-turn to open or close. Lubricant grooves surrounding each port provide a positive seal when the valve is closed. In an open position, seating surfaces are not exposed.

Available in Semi-Steel and Carbon Steel through distributors in principal cities. For descriptive literature—or help on valve problems—write direct to The Wm. Powell Company, Cincinnati 22, O.

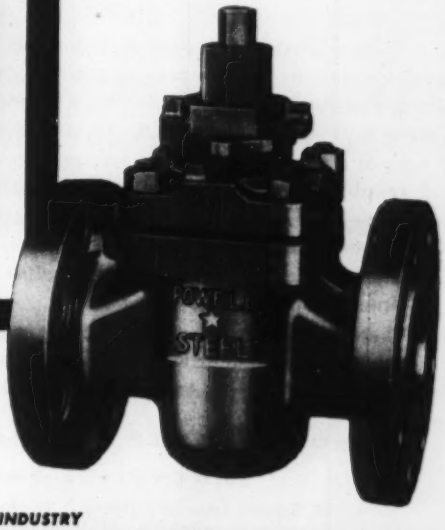


FIG. 1559 — 150-POUND STEEL FLANGED END LUBRICATED PLUG VALVE. *(300-pound Steel, Fig. 3059.)* Available with Screwed or Bolted Glands. Semi-Steel valves available for 175 and 200 pounds W.O.G. Carbon Steel valves available for 150 and 300 pounds W.P.

CONTROLS FOR THE LIFE LINES OF INDUSTRY

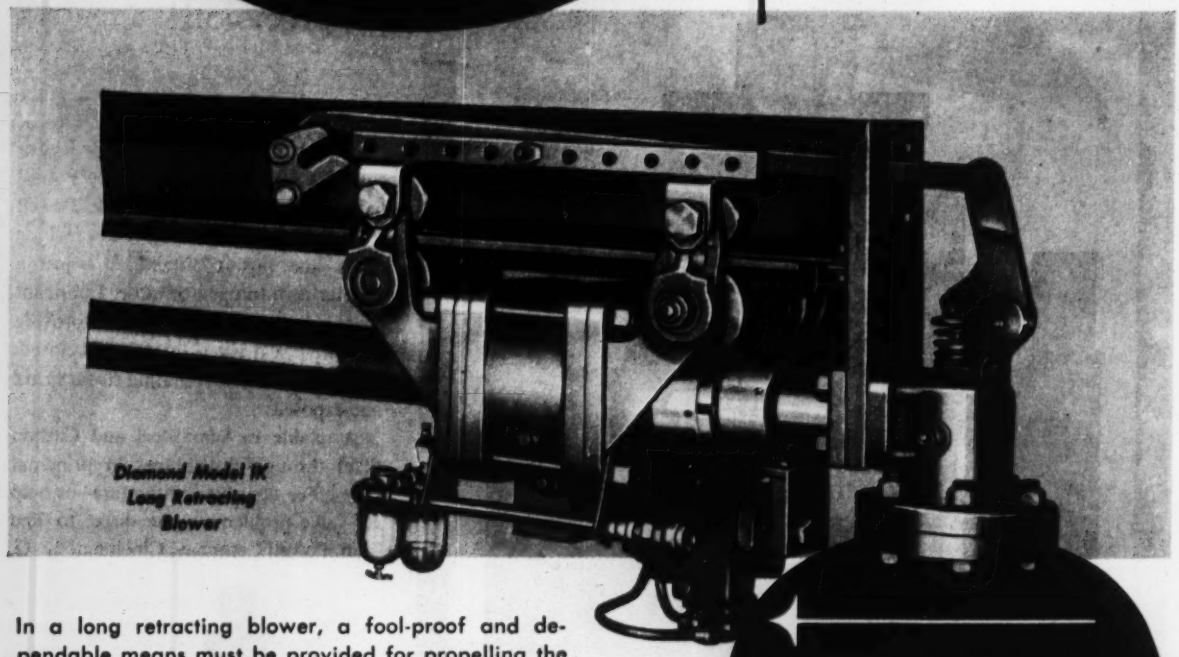
Powell Valves 108th year

One of a Series

Reasons Why

DIAMOND BLOWERS
Assure
CLEANER BOILERS
at LOWER COST

SINGLE MOTOR DRIVE



Diamond Model IK Long Retracting Blower

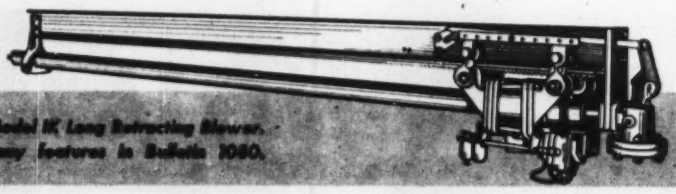
A Single Motor
(air or electric)
Both Rotates and Propels the Long Lance Tube

In a long retracting blower, a fool-proof and dependable means must be provided for propelling the carriage and rotating the lance tube. In Model IK it is done with a SINGLE MOTOR working through a simple system of rugged gears. The operating mechanism is a model of simplicity and reliability . . . only one set of motor elements, one set of control elements . . . one set of power supply facilities to operate and maintain. This drive produces a closely pitched helical cleaning pattern which is most effective for *all* deposits and tube banks . . . without tube cutting.

Other features which users approve with enthusiasm are the mechanically operated valve with adjustable pressure control, and the positive gear drive. Ask for Bulletin 1080AA.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited, Windsor, Ontario

6776



Diamond Model IK Long Retracting Blower. See its many features in Bulletin 1080.

SAVED: $120,000 on piping fabrication with...

KEY-KAST

ALLOY STEEL WELDING FITTINGS

Substantial Savings for Leading Company

PLUS These Other Outstanding KEY-KAST Benefits

1. Delivery of fittings was on *schedule* with the pipe.
2. Quality of the fittings was consistent throughout, with not one rejection.
3. Although KEY-KAST fittings were *not* ordered to radiographic quality—all weld ends were gamma rayed and KEY-KAST fittings showed up better than class 2 per ASTM E-71.

GIVE YOUR PIPING SYSTEM THE ADVANTAGES OF KEY-KAST ALLOY STEEL WELDING FITTINGS

- Greater wall thickness throughout with *extra* thickness in critical areas.
- Lower unit cost.
- Materials meet A.S.M.E. and A.S.T.M. Codes.
- Rigidly tested and inspected to meet high standards of quality.

IN ALL SHAPES, SIZES, SCHEDULES IN LOW AND INTERMEDIATE ALLOYS AND VARIOUS STAINLESS STEELS

Write for information and prices

Since 1916 . . . manufacturers and developers of products for high temperatures and pressures

key company

P. O. BOX 49A-F, EAST ST. LOUIS, ILLINOIS

[illegible]okeless Detroit Grate [illegible]kers . . .

[illegible]pital City Products Co. (Columbus, Ohio)

AWARD

Certificate
OF
Merit

THE CAPITAL CITY PRODUCTS COMPANY – WEST FIRST & PENRY STREET

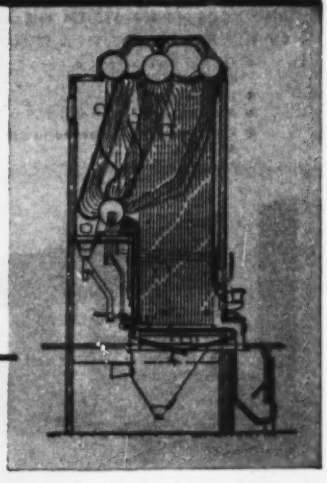
is awarded this certificate
for having operated fuel burning equipment in the
CITY OF COLUMBUS, OHIO
FOR YEAR 1952
Within limits as set forth in Ordinance 228-49
governing smoke emission

Chairman Citizens Committee

Attested by Harry C. Ballman
Chief Smoke Regulation Engineer
Division of Smoke Regulation and Inspection

The Committee of Commerce

Detroit RotoGrate Stokers in the plant of Capital City Products Company, Columbus, Ohio.



This Detroit RotoGrate Stoker has been certified smokeless by the City of Columbus, Ohio. This certificate awarded by the Citizen's Committee, and affirmed by the Smoke Regulation and Inspection Division is proof of performance.

Detroit RotoGrate Stokers operate without smoke because of their many features of design including precise control of fuel feed, grate speed and air supply.

RotoGrate is a modern spreader stoker with grates that move slowly forward discharging the ash at the front. They burn any type of Bituminous Coal or Lignite . . . handle rapidly fluctuating loads with uniform pressure over long periods.

Have you a smoke problem? Or a problem of fuel cost? Ask for details on the RotoGrate. No obligation.

DETROIT STOKER COMPANY

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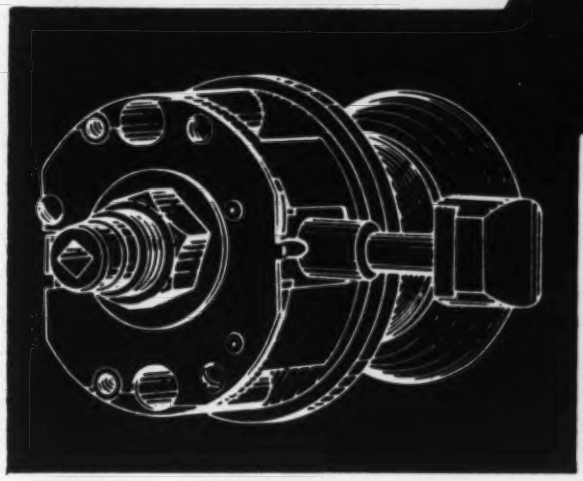
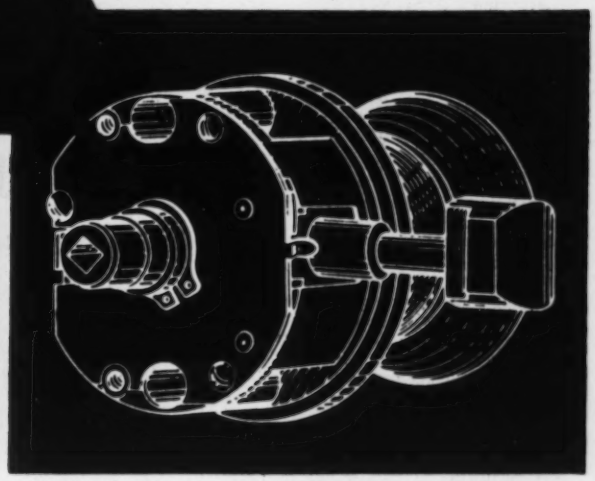
Works at Monroe, Michigan · District Offices in Principal Cities

Waldes Truarc Ring Replaces Nut and Washer ...Cuts Costs $5.28 Per M...Speeds Assembly by 50%



OLD WAY. Main shaft required costly threading. Assembly was slowed by the double application of washer and nut and time-consuming tightening operation.



TRUARC WAY. Truarc Retaining Ring snaps quickly and simply over shaft. Lock assembly is secured in one fast operation. Virtually all play is eliminated from lock.

NEW DESIGN USING WALDES TRUARC RING PERMITTED THESE SAVINGS

OLD WAY		
Cost of Nut	$10.00	per thousand
Cost of Washer	3.80	" "
Labor for Threading	2.00	" "
Assembly	3.00	" "
TOTAL	$18.80	

TRUARC WAY		
Cost of Truarc Ring and Grooving Operation	$11.52	per thousand
Assembly	2.00	" "
TOTAL	$13.52	

J. Chesler and Sons, Inc., Brooklyn, N.Y., manufacturers of the pre-assembled "Reddi-Mount" cylindrical lockset, uses a single Waldes Truarc Retaining Ring instead of an old fashioned nut and washer to secure the entire assembly of their lock. This new, improved fastening method enables Chesler to eliminate costly threading . . . save money on material . . . speed assembly time by 50% and produce an improved, more durable product.

You, too, can save money with Truarc Rings. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better, more economical job. Waldes Truarc Rings are precision-engineered . . . quick and easy to assemble and disassemble.

Find out what Waldes Truarc Retaining Rings can do for you. Send your blueprints to Waldes Truarc engineers.

For precision internal grooving and undercutting...Waldes Truarc Grooving Tool

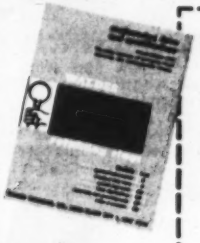
SEND FOR NEW CATALOG

WALDES

TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS



WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,383,947; 2,392,948; 2,416,892; 2,420,941; 2,439,789; 2,441,848; 2,459,189; 2,420,941; 2,483,380; 2,483,383; 2,487,802; 2,487,903; 2,491,306; 2,509,091; AND OTHER PATENTS PENDING.

ME066

Waldes Kohinoor, Inc., 47-16 Austel Pl., L. I. C. 1, N. Y.

Please send me the new Waldes Truarc Retaining Ring catalog.

(Please print)

Name.....

Title.....

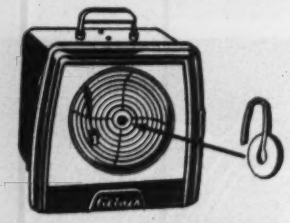
Company.....

Business Address.....

City..... *Zone*..... *State*.....

News About Created-Metals

Thermistors Stabilize Circuit Resistance



A Carboloy Thermistor improves the accuracy and sensitivity of the Tektolog Electronic Recorder.

Matching the negative temperature coefficient of a Thermistor and a low-resistance manganin shunt to the positive temperature coefficient of the copper coil results in a circuit of constant resistance within ± 5% for ambient temperature from 32° F. to 150° F.

The high degree of compensation is achieved with a relatively low resistance and makes possible accurate recording of voltages as low as 20 millivolts full-scale.

For more information on Thermistors for temperature compensation and detection, warning devices and controls, write: Carboloy Department of General Electric Company, 11133 E. 8 Mile Ave., Detroit 32, Michigan.

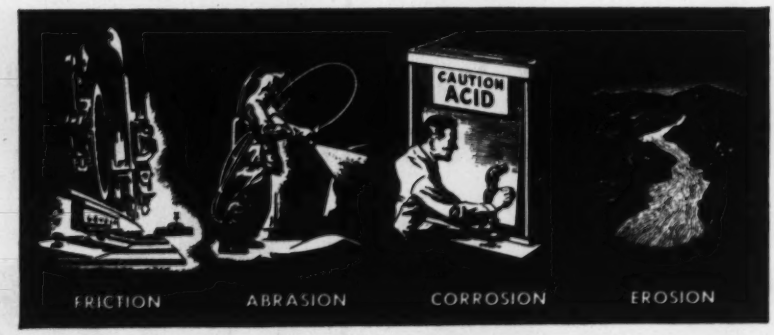
Many Uses Found for Cemented Carbides

The electronics and electrical industries are cutting costs and improving products with wear-resistant cemented carbides.

For example, tough grades of Carboloy cemented carbide are extending the life expectancy of telegraph relay contacts. Carbide-tipped tools are saving time and money in woodworking and cabinetry.

Carbide wire dies for making electric-light filaments and draw dies for making component parts far outlast steel dies. Bearings of chrome carbide are light, strong, nonmagnetic.

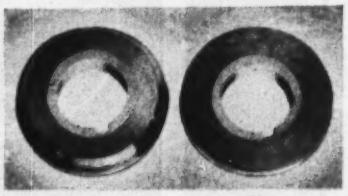
Industry is daily finding new uses for cemented carbides. The Carboloy Engineering Appraisal Service will help you put carbides to work in your plant. For more information, write: Carboloy Department of General Electric Company, 11133 E. 8 Mile Ave., Detroit 32, Michigan.



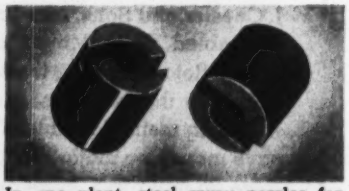
In the processing industries...

REDUCE COSTLY WEAR

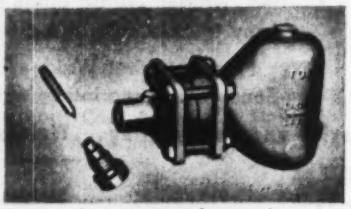
with Carboloy® cemented carbides



Dies for the extrusion or pill pressing of highly abrasive ceramics, pharmaceuticals or powdered metals, equipped with Carboloy cemented carbide, remained on the job many times longer than any other material.



In one plant, steel spray nozzles for homogenizing and dehydrating food products lasted 100 hours, due to the corrosive-abrasive action of the food products. Then Carboloy cemented carbide nozzles were used, and nozzle life increased to 3000 hours.



Steel valve stems and seats in a refrigerator regulating valve were quickly corroded and worn by ammonia. To resist this, inserts of Carboloy cemented carbide were substituted. Valve life increased 5 to 6 times.

WHERE ACIDS, alkalis, heat, oxidation and the like reduce equipment life, you can slow down wear, reduce maintenance costs, increase production and improve product quality with Carboloy cemented carbides.

The Carboloy organization manufactures cemented carbides in standard stock items, or designs them to your specifications for spray nozzles, steam valves and orifices for processing foods, soaps and drugs. Plus countless other applications such as core pins for ceramic baking where friction, corrosion, erosion and abrasion must be resisted.

Ask your equipment manufacturer, or write us, about strategic parts made wear-resistant through use of Carboloy cemented carbides.

Put These Outstanding Characteristics To Work In *Your* Plant:

- High abrasion resistance
- High corrosion resistance
- High erosion resistance
- High heat resistance
- High impact strength
- High friction-wear resistance
- Nonmagnetic
- Light weight (where desired)

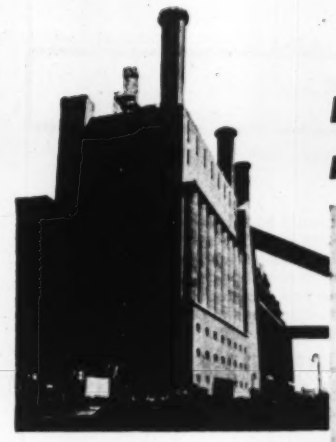
CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY

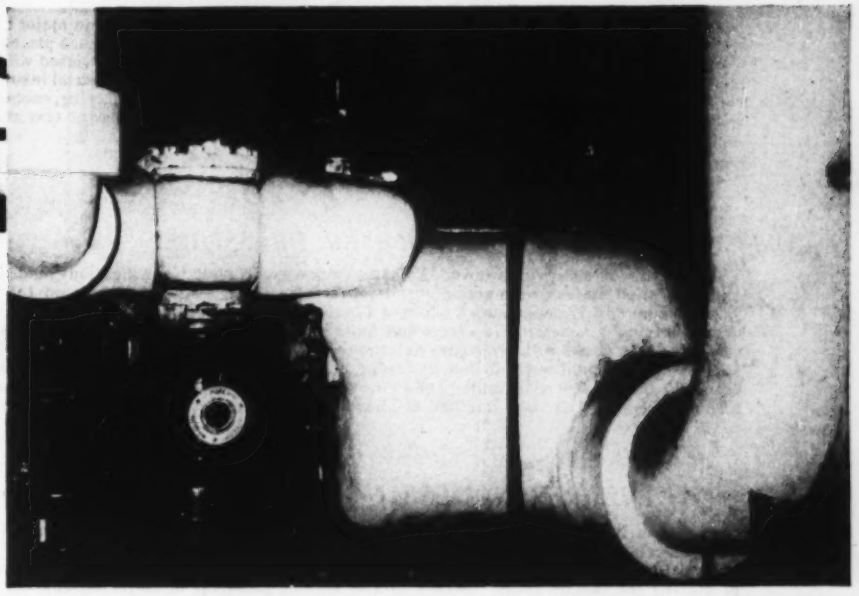
11133 E. 8 Mile Ave., Detroit 32, Michigan

"Carboloy" is the trademark for products of the Carboloy Department of General Electric Company

SETTING THE PACE FOR INDUSTRIAL PROGRESS



For this new addition to their New York City power plant at East River and 14th Street . . .



(Above) View of recently completed annex to Consolidated Edison's power plant . . . another link in their gigantic expansion program. **(Right)** Close-up of J-M 85% Magnesia Insulation on boiler feed lines. It was expertly installed by the Asbestos Construction Company, Inc., an outstanding J-M Insulation Contractor.

CON EDISON SPECIFIES J-M 85% MAGNESIA PIPE INSULATION FOR MAXIMUM FUEL SAVINGS

Like all materials that went into the new power plant addition of New York's leading gas and electric supplier . . . the pipe insulation had to be the *best*. That's why Consolidated Edison Co. specified J-M 85% Magnesia . . . industry's No. 1 insulation for many decades and *still* the leader in its class.

J-M 85% Magnesia is the leading insulation on the market for temperatures up to 600F. It is bonded with asbestos fibers. This rugged insulation will not distort regardless of the length of time it stays in service. J-M 85% Magnesia fits snug and stays put. Heat savings, therefore, remain constant for the life of the equipment on which this insulation is applied.

For temperatures over 600F, J-M 85% Magnesia is used in combination with Superex*, a J-M insulation for service to 1900F. This double-layer construction, known as Superex Combination, eliminates through joints and protects the jacket against scorching. It also utilizes the higher heat resistance of Superex next to the hot surface, and the greater insulating value of J-M 85% Magnesia for the outer layer.

*Reg. U.S. Pat. Off.

Experience has proved that all insulations must be properly installed to pay maximum dividends. That's why Johns-Manville offers industry the services of experienced insulation engineers and installation contractors who have made a career of solving complex insulation problems. From coast to coast, these engineers and the contractor's highly skilled mechanics stand ready to combine their talents and give you an insulation job that will more than pay off your initial investment with maximum fuel savings through the years.

When you face your next insulating problem . . . remember that Johns-Manville is "Insulation Headquarters." Consult your near-by J-M Insulation Contractor . . . or write direct to Johns-Manville, Box 60, New York 16, New York. In Canada, write 199 Bay Street, Toronto 1, Ontario.

Skilled Applicators on the team of a J-M Insulation Contractor applying J-M 85% Magnesia to pipelines. Located throughout the nation, these contractors have had years of experience handling all types of installations. They know J-M 85% Magnesia and other J-M insulations as *quality* products, and take pride in applying them properly. Result: an insulation job that pays dividends through the years in maximum fuel savings.

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MATERIALS • ENGINEERING • APPLICATION

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VISCOSITY OF LUBRICANTS UNDER PRESSURE

This new publication reviews and co-ordinates twelve experimental investigations made in England, Germany, Japan, Russia, and the United States over a period of thirty-five years. The tests were made on 148 lubricants comprising 25 fatty oils, 94 petroleum oils, 17 compounded oils, and 12 other lubricants. Data are co-ordinated by means of sixty tables in which the results originally appearing in diversified units are compared. The methods proposed for correlating viscosity-pressure characteristics of oils with properties determined at atmospheric pressures are reviewed and illustrated. Pertinent aspects such as experimental work on heavily loaded bearings, lubrication calculations, and additional techniques for viscosity are covered. Conclusions and recommendations are presented. Other chapters give the required computation of the temperature coefficients of viscosity, method of computing pressure coefficients, a bibliography of 189 items, and symbols used.

$5.00*

METALS ENGINEERING—DESIGN

This first of the four-volume ASME Handbook is the design engineer's own guidebook of vital data on the properties, testing, inspection, and selection of metals. Comprising 48 sections and written by 43 well-known authorities, it provides: Criteria for facing the over-all problems of selection of materials; facts on potential weaknesses of various metals and ways of making the metals strong; details of the specific problems of corrosion and the mechanical factors which influence corrosion; present knowledge of testing by nondestructive methods; special requirements of design and surface finish set up by mass production; modern basic information on the design theory, design practice, experimental design; and the special requirements of aluminum and magnesium. Here, too, are important design data—equations for determining such factors as stress, creep, impact strength; results of such methods as the use of residual stresses to improve fatigue resistance, the use of flame hardening to increase resistance to fatigue failure; methods for making your structure or machine part stronger, such as shot peening, cold working, and case carburizing.

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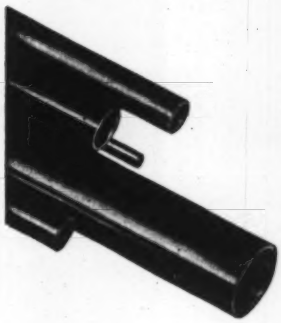

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These new Yoder mills, incorporating the patented Yoder-Tocco induction welder, among other advantages afford welding speeds from 150 to 250 fpm. on pipe and tube sizes from ⅜ in. up to 3½ in. dia. This means almost 100% increased production of fine tubing compared with any resistance or induction welder known or actually built, in the U.S.A. or any other country.

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- ★ **COLD-ROLL-FORMING and auxiliary machinery**
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HAVE YOU A DISASTER PLAN FOR YOUR PLANT?

BOMBS...OR FIRE...OR FLOOD...OR TORNADO ...you can handle them if you act now.

Let's face it... the threat of war and the atomic bomb has become a real part of our life—and will be with us for years. Fires, tornadoes and other disasters, too, can strike without warning.

Whatever the emergency is, everybody's going to want help at the same time. It may be hours before outside help reaches you. The best chance of survival for you and your workers—and the fastest way to get back into production—is to know what to do and be ready to do it. Disaster may happen TOMORROW. Take these simple precautions TODAY:

☐ **Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.

☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

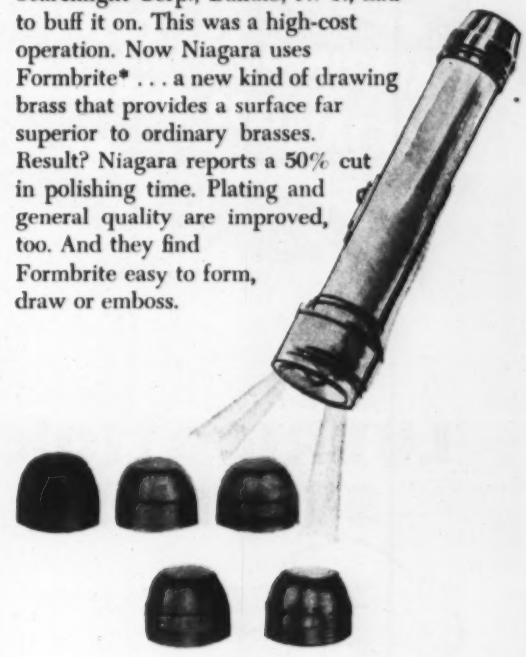
Act now . . . check off these four simple points . . . before it's too late.

ANACONDA METALS AT WORK

The American Brass Company develops a new kind of brass that cuts polishing time 50% for one manufacturer and improves product appearance for another... makes bronzes that extend the life of many metal parts

Spotlight on high luster at low cost

The high luster on these brass flashlight end caps didn't come naturally. Niagara Searchlight Corp., Buffalo, N. Y., had to buff it on. This was a high-cost operation. Now Niagara uses Formbrite* . . . a new kind of drawing brass that provides a surface far superior to ordinary brasses. Result? Niagara reports a 50% cut in polishing time. Plating and general quality are improved, too. And they find Formbrite easy to form, draw or emboss.



Old age insurance...

It's easy to take out. And you pay no premium. All you do is specify ANACONDA Phosphor Bronze for the many components like those shown. Ten alloys are available in seven forms. All are strong and tough. They bear up under constant wear and flexings, periodic stresses, fatigue and corrosion. They resist abrasion . . . conduct heat and electricity well . . . keep their high elasticity. We'll be glad to help you select the Phosphor Bronze Alloy that's just right for your job.

What's in a nameplate?

According to the Arlen Trophy Co., Brooklyn, N. Y., one of the largest trophy and premium manufacturers in the country, the *appearance* of a nameplate often means the difference between landing or losing a sale. But price is important, too. That's why Arlen now makes their nameplates out of Formbrite. It costs no more than ordinary brasses. Yet, because of its superfine grain structure, it polishes to a bright finish in half the time. Formbrite results in harder, stronger, springier, more scratch-resistant products, too.

5482

Want more information?

Our Technical Department can give you a wealth of information on the properties and applications of Formbrite and Phosphor Bronze. Write to: *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

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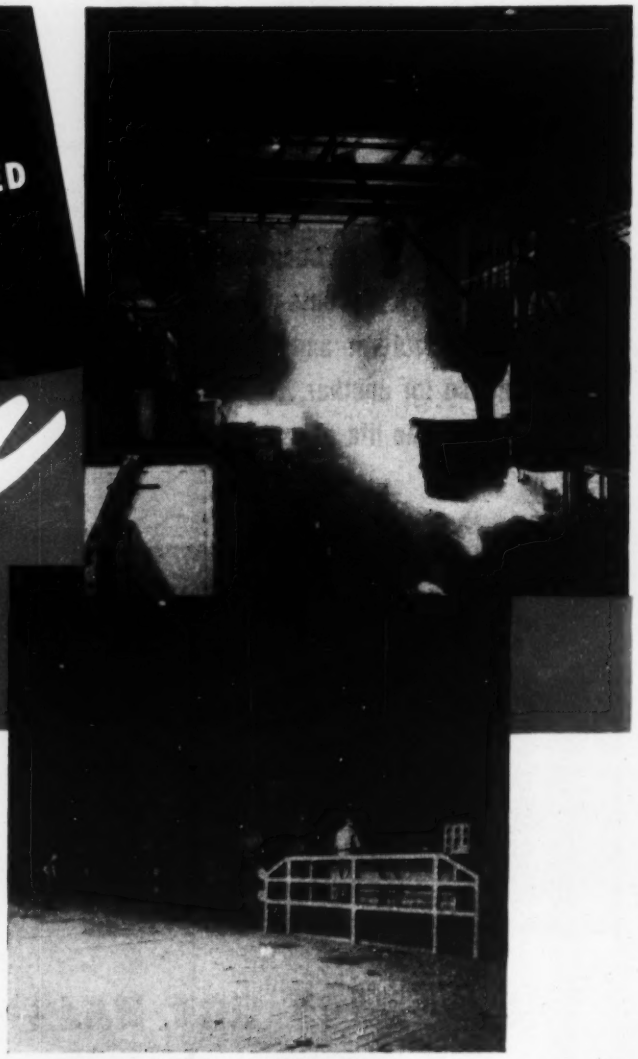
ANACONDA®

the name to remember in COPPER • BRASS • BRONZE

OVER 20,000 BEARINGS ARE LUBRICATED AT FAIRLESS WORKS BY

Trabon

LUBRICATION SYSTEMS



PHOTOS COURTESY U. S. STEEL CORPORATION

The following wide range of equipment at U. S. Steel's new Fairless Works is lubricated around the clock by TRABON *positive* lubrication systems: Wellman Ore Bridge; E. W. Bliss Hi Scale Breakers; Arthur G. McKee Blast Furnaces; Atlas Ore Transfer Cars; Wean Combination Line; Alliance Cranes; Cleveland Cranes; American Bridge Cranes; Wellman Charging Machines; Dravo Ore Unloaders; E. W. Bliss 80" Pickle Line; Mesta 45" Slabbing Mill; Mesta 80" Hot Strip Mill; Morgan 10" Merchant Mill; Continental 40" Blooming Mill; United Billet Mills; Morgan Scale Yard Crane; E. W. Bliss Cold Mills.

This installation of TRABON systems, automatic and manual, assures each bearing point accurate lubrication as frequently as it is required. Not a bearing is under-lubricated or skipped, thus eliminating costly equipment breakdown and bearing loss.

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Trabon ENGINEERING CORPORATION

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Lunkenheimer builds valves to *last*. Back in 1928, a 10-inch Steel Gate Valve was installed in the electric plant in Hamilton, Ohio. After 25 years of steam service at 625°F., the valve was *relocated* on a 725°F. steam line serving a new 10,000 kilowatt turbine generator. *A quarter century of service* — and this Lunkenheimer Steel Valve starts a new job!

This is typical of the dependable service that's built into every Lunkenheimer Valve. Take advantage of Lunkenheimer leadership in design, materials, and workmanship. Specify and use Lunkenheimer Valves — service-engineered for *your* applications. The Lunkenheimer Company, Cincinnati 14, Ohio

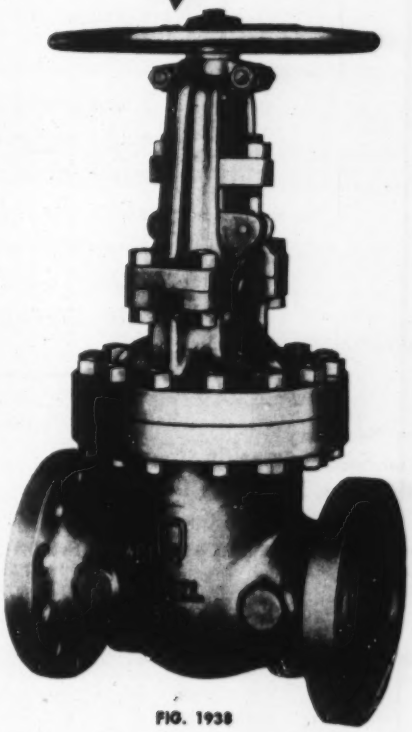

FIG. 1938

The cost of a Lunkenheimer Valve gets smaller and smaller and smaller with each passing year of dependable service.

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THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

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ME-6-54

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. . . when critical piping is the order!

Mechanical engineers are quite familiar with the fact that today's high operating temperatures may produce severe expansion stresses and reactions in high temperature power piping systems. But the accurate determination of these by analytical methods can involve extremely complicated and tedious mathematics.

A proved means for eliminating much of the expense of this essential engineering is the Kellogg Model Tester. This device's patented electrical measuring heads (illustrated), together with its servo-operated electronic equipment, enable Kellogg engineers to make complete analyses of thermal effects including line movements . . . at low cost.

For very complicated piping systems, the model tester is the only practical method of obtaining accurate solutions. For simpler systems, it serves as a relatively inexpensive check on calculated results. Furthermore, once the permissible reactions are established for loadings at the throttle valve and the superheater header connections, the optimum design for the remainder of the system can be developed without removing the model from the tester. For analyses of less complicated piping systems, Kellogg engineers employ a modern IBM computer to reduce costs and time required to arrive at results.

Well-conceived support and anchor designs for the suspension and expansion control of all classes of lines are readily established from the information furnished by the model tester. It can also provide data to insure proper handling of the piping in the field, during welding and heat treating . . . minimizing strains, due to extraneous loadings, which might be detrimental to the production of soundly welded joints.

This approach to the problems of critical power piping—the development of new and improved methods, of less expensive methods—is Kellogg's basic stock in trade. Many power station designers and utility companies also say it's the basic reason why they repeatedly specify *"critical power piping by Kellogg."*

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NEW POWER PIPING BOOKLET . . . Send for descriptive literature about Kellogg's extensive facilities for assuring the highest quality workmanship.

These leading companies are among the many major producers of power who use M. W. KELLOGG POWER PIPING . . .

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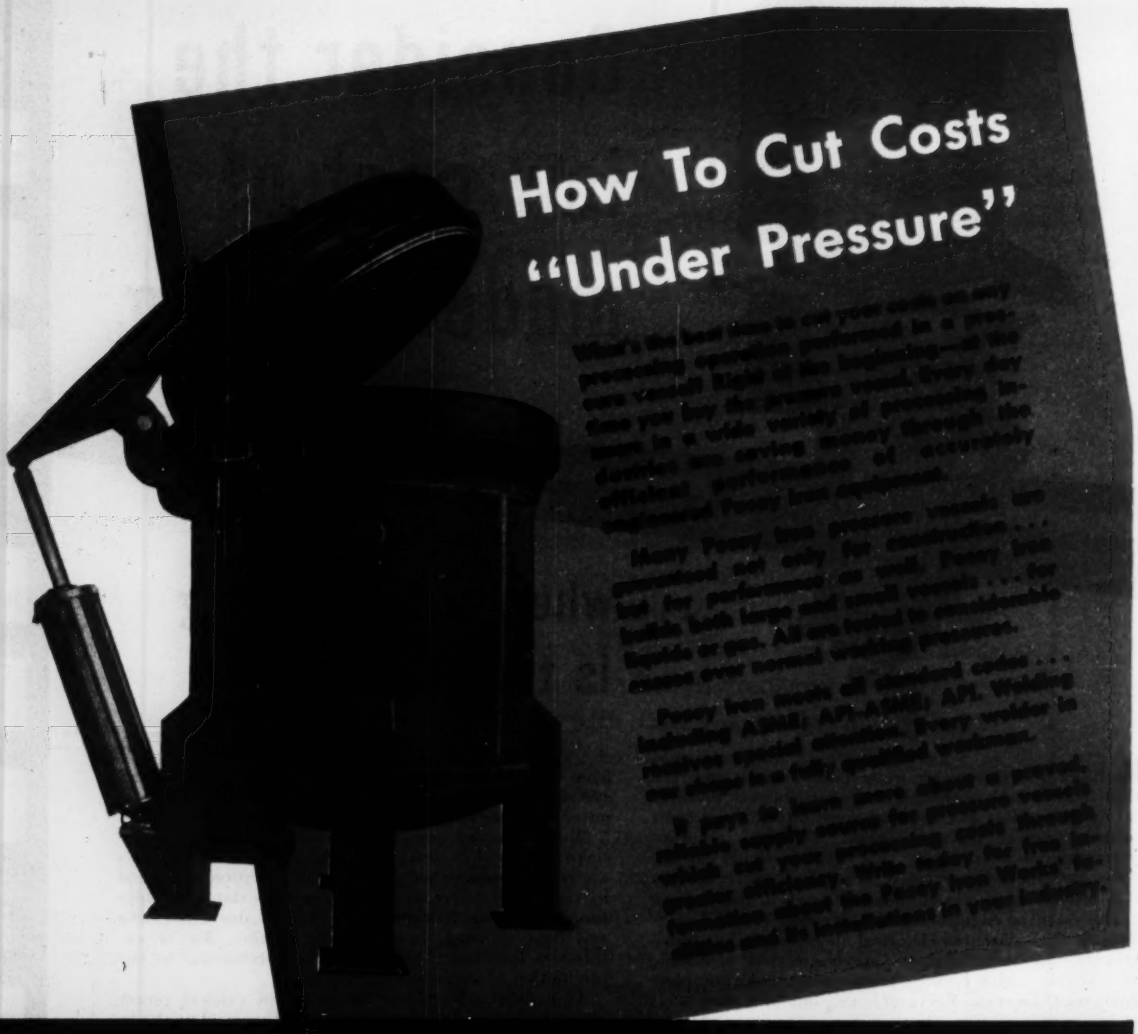

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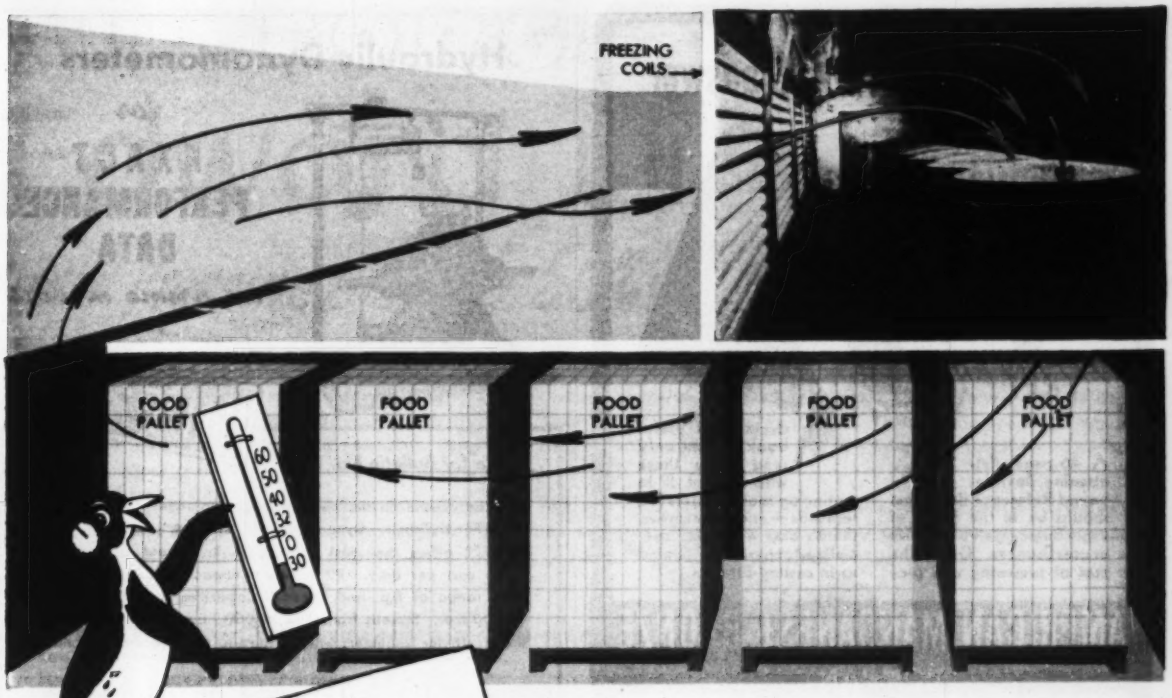


JOY

® AXIVANE FANS HANDLE SEVERE QUICK-FREEZE JOB

A West Coast quick-freezing plant boasts an effective operation that utilizes 24 Joy 7½ HP Series 1000 Axivane Fans, installed in two groups of 12 each.

Note the illustration above. The upper floor contains freezing coils and a row of 12 fans. The floor below is partitioned into narrow freezing tunnels, each served independently by a single Joy fan.

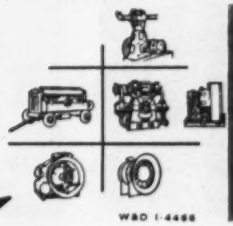
As air passes through the freezing coils, it is cooled to between —30° and —35°. This sub-zero air is propelled down and through the tunnels below, which contain pallets of meat, vegetables, fruit, etc. to be quick-frozen. After passing over the food, the air is again cooled and circulated. At full plant load, each 12-fan battery handles 242,000 CFM of air.

The relatively quiet operation, light weight, compactness and low power consumption of Joy Axivane Fans—due to the unmatched efficiency of their vaneaxial design—have proved *real* advantages on this job. Their in-line construction also saves space, since each fan can be mounted right in its short, vertical duct. In addition, extreme flexibility of operation is made possible by the adjustable blades, a standard Joy feature. ● Let us help you to get best results on your fan problems. **Joy Manufacturing Company, Oliver Bldg., Pittsburgh 22, Pa.** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

Left: Looking up from the quick-freeze room below a Joy Axivane Fan. Note the compact, economical use of space and the simple mounting.

Consult a Joy Engineer

for Vaneaxial Fans . . . Compressors, Vacuum Pumps and Boosters . . . Oxygen Generators



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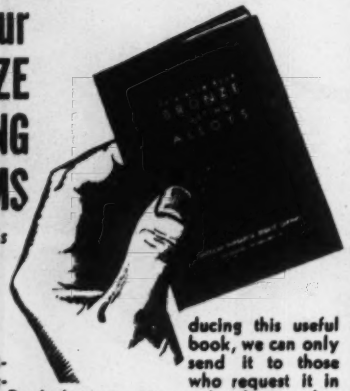

A 46-page, flat-opening, flexible-bound Reference Book that should be in the hands of every Engineer who specifies or uses Bronzes. Due to the cost of preparing and producing this useful book, we can only send it to those who request it in writing on their business letterheads—and remember, there's over 44 years "specialized experience" behind us in casting Bronzes.

AMERICAN MANGANESE BRONZE COMPANY

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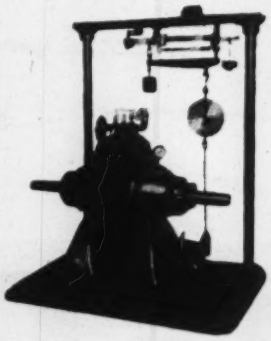
Established 1909

Hydraulic Dynamometers *for* EXACT PERFORMANCE DATA *on prime movers*



HI-EFF

Write for Bulletin No. 760

You can depend on the performance data taken from a Taylor "HI-EFF" Hydraulic Dynamometer. Efficient, compact Taylor "HI-EFF" offers the most economical investment and maintenance cost per hour. 72 different capacity models each with wide range of h.p. and speed. Capacities from fractional to 10,000 h.p. Speeds from 0 to 25,000 r.p.m. Reversible if desired. Taylor engineers will be glad to make recommendations.

Dynamometers • Static Balancers • Precision Drilling Machines

TAYLOR DYNAMOMETER & MACHINE CO.
6411 RIVER PARKWAY MILWAUKEE 13, WIS.

The NEWEST development in V-ring packings

LINEAR VEE-DAM* RINGS

Footproof to assemble
leakproof in operation

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR Inc., State Rd. & Levick St., Philadelphia 35, Pa.

Use a Classified Advertisement in MECHANICAL ENGINEERING *for quick results*

REPRESENTATIVES AVAILABLE REPRESENTATION WANTED
BUSINESS OPPORTUNITIES MANUFACTURING FACILITIES
EQUIPMENT FOR SALE or WANTED PATENT ATTORNEYS
HELP WANTED POSITIONS WANTED
EMPLOYMENT AGENCIES AND SERVICE BUREAUS

If you desire capital or have it to invest; if you have a patent for sale or development; if you have on hand used machinery for disposal, or if you want such equipment; if you have copies of publications, or a set of drawing instruments to dispose of; if you need help or want a position, in fact anything to be offered that somebody else may want, or anything wanted that somebody else may have—*use a classified advertisement in the Opportunities Section.*

RATES

Classified advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line, $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display matter carried in single column units of multiples of one inch at the flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS
29 West 39th Street, New York 18, N. Y.

ALL FORGED STEEL

Edward UNIVALVES

Lower Pressure Drop 25-50% with Straight-Thru Flow

As shown photographically here, the streamlined internal contours and the inclined stem construction of the Edward Univalve give straight through flow — which careful laboratory tests have shown to result in pressure drop 25 to 50% lower for Univalves than other globe valve types. Turbulence, too, is greatly lowered by these streamlined contours. And lowering turbulence lengthens valve life by eliminating vibration, the principal cause of wear in small globe valves.

But lower-pressure drop and less turbulence are not the only reasons the Univalve has become an industry standard for tough high pressure, high temperature services. Here are just a few of the benefits which add up to longer life and lower maintenance for this outstanding Forged Steel Valve.

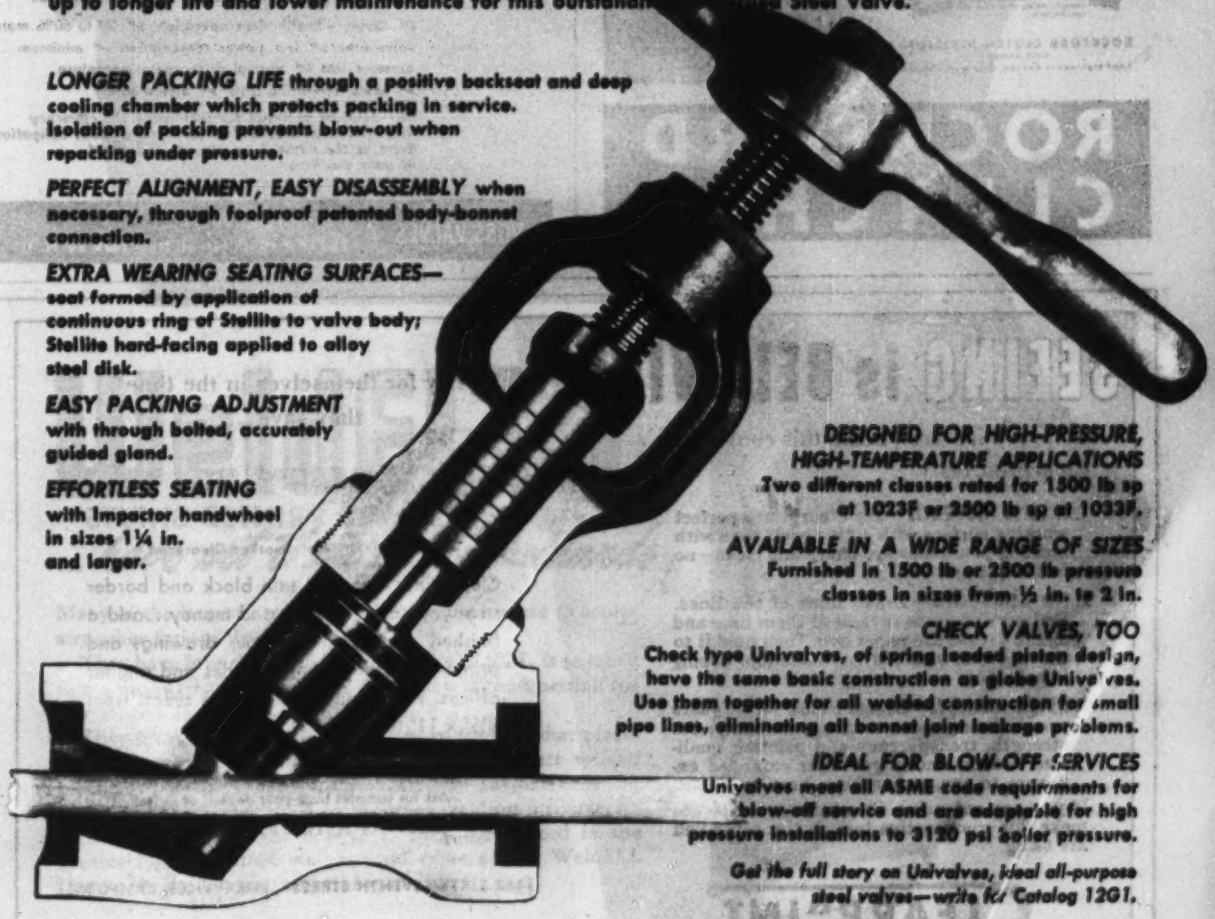
LONGER PACKING LIFE **through a positive backseat and deep cooling chamber which protects packing in service. Isolation of packing prevents blow-out when repacking under pressure.**

PERFECT ALIGNMENT, EASY DISASSEMBLY **when necessary, through foolproof patented body-bonnet connection.**

EXTRA WEARING SEATING SURFACES— **seat formed by application of continuous ring of Stellite to valve body; Stellite hard-facing applied to alloy steel disk.**

EASY PACKING ADJUSTMENT **with through bolted, accurately guided gland.**

EFFORTLESS SEATING **with Impactor handwheel in sizes 1¼ in. and larger.**



DESIGNED FOR HIGH-PRESSURE, HIGH-TEMPERATURE APPLICATIONS
Two different classes rated for 1500 lb sp at 1023F or 2500 lb sp at 1033F.

AVAILABLE IN A WIDE RANGE OF SIZES
Furnished in 1500 lb or 2500 lb pressure classes in sizes from ½ in. to 2 in.

CHECK VALVES, TOO
Check type Univalves, of spring loaded piston design, have the same basic construction as globe Univalves. Use them together for all welded construction for small pipe lines, eliminating all bonnet joint leakage problems.

IDEAL FOR BLOW-OFF SERVICES
Univalves meet all ASME code requirements for blow-off service and are adaptable for high pressure installations to 3120 psi boiler pressure.

Get the full story on Univalves, ideal all-purpose steel valves—write for Catalog 1201.

Rod through Univalve demonstrates straight thru flow of this valve.

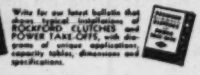
Edward Valves, Inc.
Subsidiary of ROCKWELL MANUFACTURING COMPANY
1350 West 145th St., EAST CHICAGO, INDIANA

Another Product

HOW TO GET THE RIGHT CLUTCH

Whatever your power transmission control requirements may be, your product will benefit by using a clutch that is exactly suited to its need. Thousands of manufacturers — in hundreds of industries — have increased the efficiency of their machines with the right ROCKFORD CLUTCHES. Our engineers are not restricted to any one type or size of clutch — but are free to specify one that is best suited to the particular operating essentials of your product.

Write for our latest bulletin that shows typical installations of ROCKFORD CLUTCHES and POWER TAKE-OFFS, with diagrams of unique applications, capacity tables, dimensions and specifications.



ROCKFORD CLUTCH DIVISION
BORG-WARNER
1307 Eighteenth Avenue, Rockford, Illinois

ROCKFORD CLUTCHES

install peak performance into your compressors (AIR · GAS · AMMONIA)

J. H. H. VOSS VALVES
REG. U.S. PAT. OFF.

Peak performance, maximum efficiency, greater output, and lower power costs can be built into your oldest, and of course your newest, compressors by the installation of VOSS VALVES.

Check THESE VOSS VALVE ADVANTAGES:

✓ Quiet, vibration-free operation ✓ 20 to 60% more valve area ✓ less power consumption ✓ minimum pressure loss ✓ normal discharge temperature ✓ lower operating costs ✓ utmost safety

Our detailed proposal for increasing the efficiency of your compressor will be sent you without obligation. Send us the name, bore, stroke, and speed of your machine.

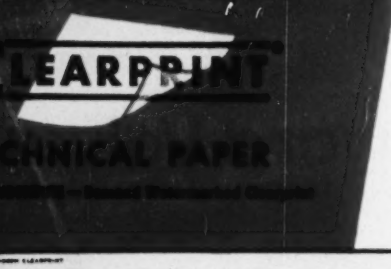
VOSS VALVES / J. H. H. VOSS Co., Inc.
784 East 144th Street, New York 54, N. Y.

SEEING is BELIEVING!

To prove it's best, make this convincing Clearprint test:

1. SEEING THE PENCIL—Try Clearprint's perfect working surface with a 2H pencil, then with a ruling pen. Lines are sharp and clean—no feathery edges.
2. NO GHOSTING—Erase some of the lines. Redraw and erase several of them time and again. Crease the paper, too. Then hold it to the light, or make a reproduction. Seeing is believing!
3. NEVER CHANGES—Sheets in use for 20 years prove Clearprint's amazing stability. Its strength, transparency and printing qualities remain unchanged after extended exposure to age, atmosphere, heat and light.

If you are not using Clearprint now, please make this comparison test on the paper you are using.



Pay for themselves in the time they save...

CLEARPRINT STANDARD PRINTED SHEETS

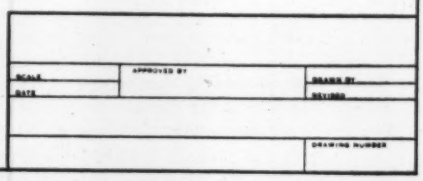
on No. 1000H Watermarked Clearprint

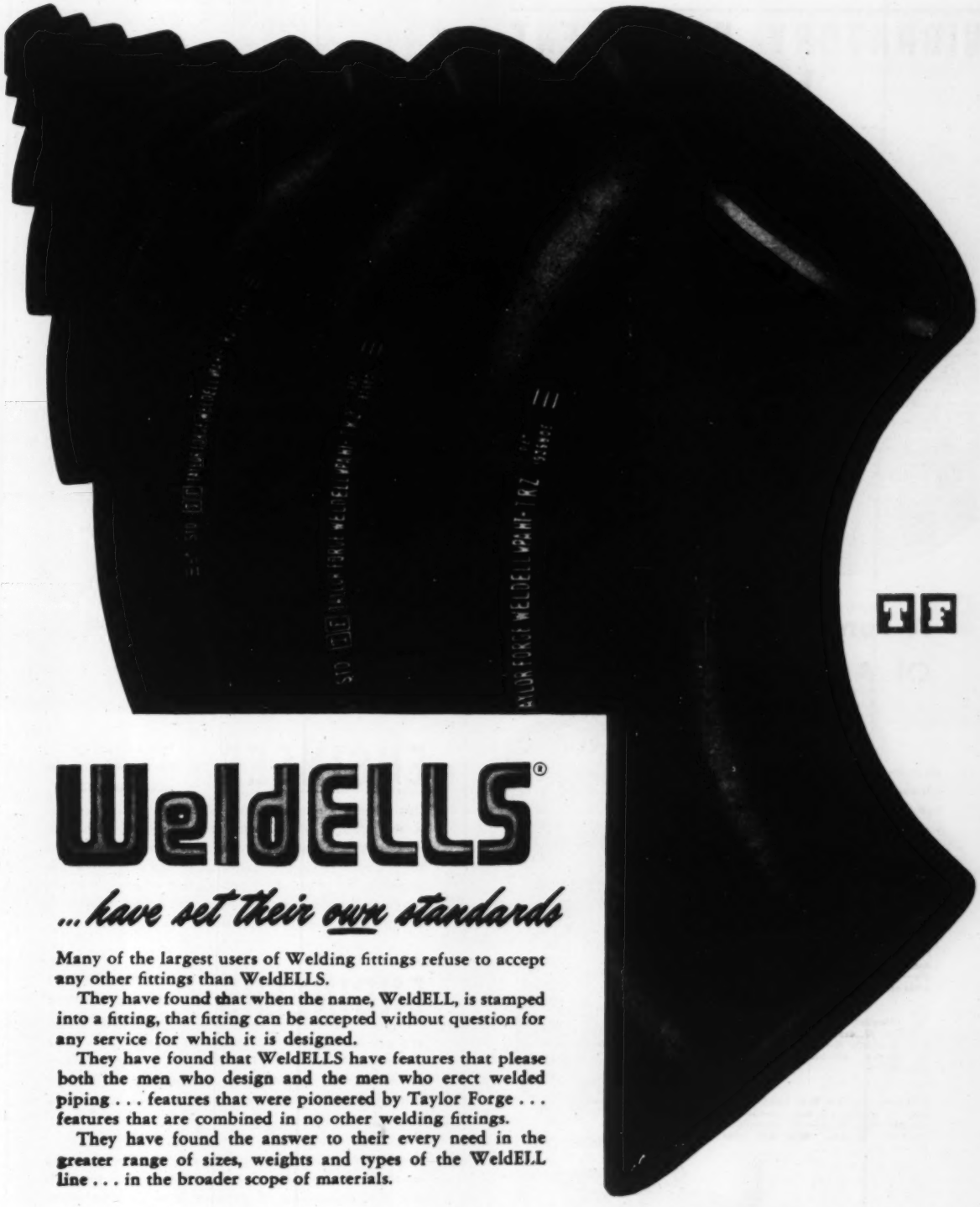
Clearprint's standard title block and border save you valuable time and money...add a finished appearance to your drawings and prints. Ideal for routine sketches and smaller offices. Printed in standard size sheets from 8½" x 11" to 24" x 36".

Ask for samples from your dealer, or write:

CLEARPRINT PAPER CO.

1482 SIXTY-SEVENTH STREET EMERYVILLE, CALIFORNIA





WeldELLS®

...have set their own standards

Many of the largest users of Welding fittings refuse to accept any other fittings than WeldELLS.

They have found that when the name, WeldELL, is stamped into a fitting, that fitting can be accepted without question for any service for which it is designed.

They have found that WeldELLS have features that please both the men who design and the men who erect welded piping . . . features that were pioneered by Taylor Forge . . . features that are combined in no other welding fittings.

They have found the answer to their every need in the greater range of sizes, weights and types of the WeldELL line . . . in the broader scope of materials.

TAYLOR FORGE

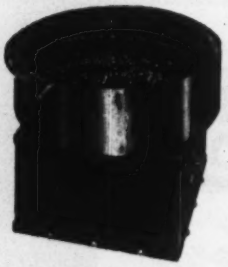
TAYLOR FORGE & PIPE WORKS, General Offices and Works: P.O. Box 485, Chicago 90, Ill.
Offices in all principal cities. Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

VIBRATORY EQUIPMENT by SYNTRON

Syntron Parts Feeders feed ceramic wafers to circuit printer in automatic assembly of electronic equipment.

A Fundamental Part Of Automatic Production

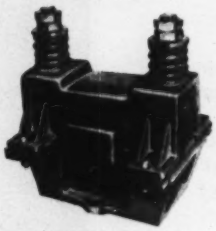
Electromagnetic drive—positive finger-tip control of operating speeds and complete absence of mechanical wearing parts, such as belts, cams, pulleys, etc., make Syntron Vibratory Equipment exceptionally well suited for incorporation into automatic or semi-automatic production systems.



PARTS FEEDERS

Parts Feeders that feed small parts of nearly any shape or material—single file—in oriented position—at controllable speeds.

Bin Vibrators that assure a positive free-flow of even the most stubborn bulk materials through bins, hoppers and chutes. Eliminate arching and plugging.



BIN VIBRATORS

Vibratory Feeders that handle most bulk materials from fine powders to coarse heavy lumps—at controllable rates—to conveyor belts, ball mills, mixers, etc.

VIBRATORY FEEDERS

Write for free catalog data — or inquire about your own handling problem.

SYNTRON COMPANY
498 Lexington Avenue Homer City, Penna.

ENGINEERING for PRODUCTION

We have need at Hughes for an engineer broadly qualified in design for production.

This man will direct the *engineering for production* of major precision electromechanical components for missile guidance and control systems. Advanced gyroscopic, hydraulic, and electronic components, already proved fundamentally, must be optimized for weight reduction, manufacturability, and reliability.

Qualifications must include adequate fundamental training followed by wide experience in bringing small precision electromechanical devices to the production stage.

HUGHES Scientific and Engineering Staff

RESEARCH AND DEVELOPMENT LABORATORIES
Culver City, Los Angeles County, California

Assurance is required that relocation of the applicant will not cause disruption of an urgent military project.

ENGINEER • FOR DESIGN OF INSTRUMENTS AND ALLIED CONTROLS

Opportunity for an engineer to fill responsible position in the design of automotive instruments, industrial temperature gages, recorders and controllers. Should have about 10 years' experience and will have the responsibility of handling redesigning of present products and the designing of new units to be added to the line of automotive and aircraft instruments.

Junior ENGINEERS • FOR INDUSTRIAL AND AUTOMOTIVE INSTRUMENTS

We are looking for two young engineers who will be given responsibility and opportunities for advancement as fast as they can move up. Assignments will be with either industrial instruments or automotive instruments.

■ ■ ■

Investigate your opportunities with this fast growing leader in the industry. The addition of new products and the expanding of present lines provide many opportunities for rapid advancement.

Modern Retirement
Company-Paid Life Insurance
Opportunities in Diversified Fields

THE ELECTRIC AUTO-LITE COMPANY
TOLEDO 1, OHIO

STEP AHEAD...KEEP AHEAD

with the RELIANCE V★S DRIVE Jr. 3/4 to 3 HP

STYLE E

The Reliance V★S Drive Jr., is an All-Electric Adjustable-Speed Drive that eliminates mechanical gearboxes, clutches and variable-pitch cone pulleys.

It is bringing the benefits of smooth, shockless operation . . . powerful starting . . . wide speed ranges . . . fast reversing . . . quick stopping . . . to users of small machinery in many industries.

Progressive machinery builders, too, are building these desirable sales features into their machines with the V★S Jr. To step ahead . . . and keep ahead...of competition, find out today what the V★S Jr. can do on *your* application! D-1468B

SAVES YOU MONEY 10 WAYS:

- Boosts output
- Cuts down rejects
- Saves space
- Increases safety
- Handles more jobs
- Reduces "down time"
- Simplifies machine design
- Reduces operator fatigue
- Cuts changeover time
- Operates from a-c.

Get the Facts! Ask for Bulletin D-2102. It describes and illustrates features, applications, components and operation; dimensions and characteristics also are included.

RELIANCE ELECTRIC AND ENGINEERING CO.

1062 Ivanhoe Road, Cleveland 10, Ohio • Sales Representatives in Principal Cities

"Let's talk one-piece construction!"

"We're at the crossroads, Bob. We've got to have more heat exchange capacity, yet we can't afford new equipment. What can we do?"

"Well, you've pretty much answered that question yourself. You said you were at the crossroads—I use that expression to describe the point where using Wolverine Trufin* is more economical than prime surface tube. In other words, Mr. Jones, you should retube with Trufin—the integral finned tube."

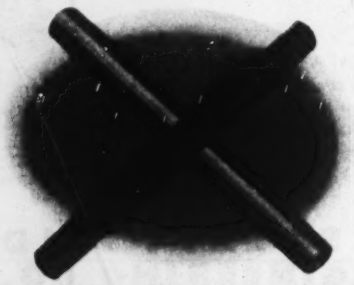
"What exactly do you mean—integral?"

"Well, let's talk one-piece construction. You see, fins are extruded right from the tube wall. Because the tube is finned, you get more heat transfer surface in a smaller area. And, because the fins are an integral part of the tube, you get more heat transfer. In short: vibration, temperature shock, pressures can't jar the fins loose. Your problem isn't any different than the one we had a month or so ago. This company had a small stand-by condenser—they also needed to boost their total condensing capacity. So, they retubed the small unit with Trufin and hooked it up in parallel with their larger prime surface unit. Well, production of the smaller Trufin unit equalled that of the larger prime surface installation. As a result, they eliminated the need for an entire new condenser!"

"Boy! If we can only do that, too!"

"You can! I'll outline the idea in a letter to you this afternoon. I can prove that you will save in the long run."

WHEN IT'S TIME TO RETUBE: be sure to consider Trufin. *It pays!* It's available in copper, copper-base alloys, aluminum, bi-metal, electric-welded steel and other metals. And write for a copy of Wolverine's Trufin Data Sheet. You'll find all the information you'll need. WOLVERINE TUBE DIVISION of Calumet & Hecla, Inc., 1483 Central Avenue, Detroit 9, Michigan.



Wolverine Trufin and the Wolverine Spun End Process available in Canada through the Unifin Tube Co., London, Ontario

*REG. U. S. PAT. OFF

WOLVERINE TUBE DIVISION
OF CALUMET & HECLA, INC
Manufacturers of Quality-Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA • SALES OFFICES IN PRINCIPAL CITIES

EXPORT DEPARTMENT, 13 EAST 40TH STREET, NEW YORK 16, NEW YORK.

Representatives—Sales Agencies
Business for Sale
Partnership—Capital
Manufacturing Facilities

OPPORTUNITIES

Positions Open—Positions Wanted—Equipment, Material, Patents, Books, Instruments, etc. Wanted and For Sale

Answers to box number advertisements should be addressed to given box number, care of "Mechanical Engineering," 29 West 39th St., New York 18, N. Y.

POSITIONS OPEN

RATES Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

WANT "IN" ON SECOND FLOOR OF A SPECTACULAR COMPANY?

Young manufacturers of revolutionary industrial products, already in million-dollar-per-year class, seek graduate mechanical engineer who is determined to "go places." Must be a convincing, persuasive salesman with proven success, and willing to travel almost constantly all over U. S., setting up and working with high-class engineering distributors. Right man will be gladly given stock participation second only to that of us who began on ground floor. Excellent starting salary, unlimited future. Write fully.

Address CA-4703, care of "Mechanical Engineering."

OPPORTUNITY

Division of firm engaged in development and pilot line production of solid propellants for rockets, boosters, and gas generating devices currently has openings for:

1. **MECHANICAL ENGINEER for pressure vessel and component design. Also possibility to function as project engineer.**
2. **MECHANICAL ENGINEER to take charge of static test facility. Should possess familiarity with usual electronic instrumentation.**

Initial reply should include qualifications and salary requirements.

Address CA-4698, % "Mechanical Engineering."

MECHANICAL DESIGN ENGINEERS

earthmoving experience with successful record in design and development of heavy mechanical equipment, crawler tractors, bulldozers or mining machinery preferred. Work includes layout and design of heavy machinery, leadership of design section. Send complete record and references. Location Salt Lake City.

Address CA-4689, % "Mechanical Engineering."

Design and Development Engineer

ME or EE

Experience in design and development of equipment to inspect, test and evaluate rotating components. Both high speed and low torque problems—ability to program use of equipment and analyze results—previous work in electro-mechanical field dealing with high performance, extreme precision, and minimum space problems desirable.

Excellent working conditions with progressive company in small New England city.

Opportunity with future responsibility and rewards commensurate with drive and ability. A challenge to a man with ingenuity. Inquire by letter giving brief description of education and experience.

Address CA-4716, % "Mechanical Engineering."

Editorial Assistant

—of long-established technical magazine in the field of general mechanical engineering. Must be graduate of engineering school with practical engineering and editorial experience. Under 30 years of age, with ability to do original writing, rewriting, and abstracting, reporting and interviewing, and willing to travel. Location New York. Permanent position. Apply by letter with photograph, record of school and engineering work, references and salary expected.

Address CA-4596, % "Mechanical Engineering."

DESIGN ENGINEER

To design machinery and apparatus, consult on fabrication, and develop ideas presented by chemists and engineers, are needed in our Research and Development Department. If you have a B.S. Degree in Mechanical Engineering and at least five years' experience in equipment and process design, send resumé stating qualifications and salary requirements to:

A. D. Preston
Technical Personnel Manager
Box 4700

THE CHEMSTRAND CORPORATION
Decatur, Alabama

MECHANICAL ENGINEERS

Caltech, Jet Propulsion Laboratory, is now offering select positions requiring a considerable degree of initiative, creative ability and responsibility.

Experienced Mechanical Engineers are needed for design and development of small auxiliary power supplies. Experience with air turbines, reciprocating gasoline engines, gas turbines or electric alternators is desirable.

Send your resumé today to

JET PROPULSION LABORATORY
California Institute of Technology
4800 Oak Grove Drive
Pasadena 3, California

ENGINEERS PHYSICISTS

Challenging positions with established, reputable firm for young BS and MS Engineers and Physicists.

Chemical Engineers—Process Development, Pilot Plant

Mechanical Engineers—Exterior Ballistics Research, Design

Physicists—Interior Ballistics Research

For research and development activities in the field of free-flight rockets and solid propellants.

Write, giving education, experience, salary history, and personal data to:

Personnel Director
Rohm & Haas Company
Redstone Arsenal Research Division
Huntsville, Alabama

opportunities

FOR EXPERIENCED

CHEMICAL

MECHANICAL • AERONAUTICAL

ENGINEERS

IN

Fuels | Combustion
Thermodynamics | Heat Transfer
Aerodynamics

To work on

DEVELOPMENT, DESIGN and RESEARCH

of Advanced Aircraft Propulsion and Combustion Components

GENERAL ELECTRIC

Aircraft Gas Turbine Division
Development Department

CINCINNATI 15, OHIO

MECHANICAL ENGINEER—or Engineering Physics major. B.S. in M.E. or Engineering Physics plus at least 2 years' experience. Mechanical aptitude and ingenuity with strong interest and good general knowledge of electronics and mathematics. A challenging opportunity for a man with versatility, energy and supervisory ability in a job limited only by creativeness and personal ability. Reply to Personnel Department, The Franklin Institute, 20th & Parkway, Phila. 3, Pa.

MECHANICAL ENGINEER—for supervisory position in Maintenance Department of large western Pennsylvania chemical plant. Excellent opportunities for advancement. Three to five years' experience desirable. Reply giving age, education experience, and salary requirement. Address CA-4656, care of "Mechanical Engineering."

MECHANICAL DESIGN ENGINEERS—For plant layout and automatic machine design. Positions entail wide range of engineering work, some electrical. Experience in pulp, paper or wallboard plants desirable but not necessary. Reply giving complete details of experience and training. Opportunities for advancement. Salary to start $5,000-$7,000 depending on age and experience. Location south. Address CA-4671, care of "Mechanical Engineering."

Well known manufacturer, AAA-1 rating, selling to virtually all industry requires sales engineer, mechanical engineering degree preferred. Age 30 to 40, previous sales experience desirable but not necessary. Straight salary and use of Company car; all traveling expenses. Location Midwest. Address CA-4719, care of "Mechanical Engineering."

INDUSTRIAL—MECHANICAL ENGINEER—We have a job with a tremendous future potential for an engineer with a high degree of mechanical and executive aptitude. We operate a highly integrated paper converting and lithograph plant and need a man with ability for plant and equipment layout, who wants to shoot for a top production job. A man 30-35 preferred. Reply to J. G. Kieber, 274 North Goodman St., Rochester 7, N. Y.

VIBRATION ENGINEER—to design equipment to be used in shock and vibration testing of electronic missile components. Would work closely with electronics engineers to determine means of eliminating the causes of failure of equipment due to shock and vibration. A minimum of four years' experience in dynamic motion is required. Our firm is affiliated with a leading university and offers the stability and atmosphere of an academic situation coupled with the monetary and professional benefits of industry. Location, Western New York. All replies will be considered confidential. Address CA-4678, care of "Mechanical Engineering."

TEACHING POSITION—Engineering graduate, industrial and teaching experience desirable. Opportunity to work on advanced degree. Salary depends upon qualifications. Write Head, Department of Engineering Drawing, Iowa State College, Ames, Iowa.

Wanted . . .

Machine tool designers

looking for real opportunity in

electrical circuit design and hydraulic control functions

In a rut where you are? Feel your progress is being blocked? Then why not give your talents a fresh start in a new, modern facility, working for an aggressive, highly respected organization, a leader in its field for over 50 years.

Here's the opportunity you've talked about. Now do something about it. The permanent expansion of our business demands qualified design engineers who can combine imagination and ability in the practical solution of machining problems (milling, drilling, boring, etc.)

There are 15 openings in this exceptional opportunity for advancement and for doing the things you like to do best — create and develop fine production machine tools. Excellent pay range commensurate with experience.

added benefits . . .

profit-sharing retirement benefits after two years service . . . liberal health insurance package . . . good labor relations . . . and located within the state that's the "Playground of the Middle West."

For full particulars write to CA-4684 care of "Mechanical Engineering". Give name, age, marital status and summary of experience. We will correspond and interview if application is suitable. All communications held strictly confidential.

Are You Making Use of These Reliable Guides to Good Gear Blank Construction?

INSPECTION OF FINE PITCH GEARS

B6.11-1951 **$2.50**

. . . especially the realistic and liberal tolerances in Section 7 of this document for various gear blank elements to produce gears of given degrees of accuracy.

DESIGN FOR FINE PITCH WORM GEARING

B6.9-1950 **$1.50**

. . . for recommendations covering gear blank design, offering two choices for throated worm gears and for non-throated gears

These American Standards are published by and obtainable from

The American Society of Mechanical Engineers

29 W. 39 St., New York 18, N. Y.

Three Pages of "OPPORTUNITIES" This Month . . . 131-133

POSITIONS OPEN

BOILER DESIGN ENGINEER—Graduate Engineer preferred. Must be familiar with ASME code. Excellent opportunity for well qualified man. Address CA-4718, care of "Mechanical Engineering."

AAA-1 Manufacturer of bearings requires SALES ENGINEER to locate near Washington, D.C. and cover certain areas to the south and north of Washington. Mechanical engineering degree preferred; considerable traveling necessary. Company furnishes car. Address CA-4720, care of "Mechanical Engineering."

MECHANICAL ENGINEERING—graduate up to 38, advanced degree preferred, to teach heat engines and related subjects. Salary and rank depend upon qualifications. New building and equipment. Start September 1, 1954. Apply to the Dean of the School of Engineering, University of Mississippi, University, Mississippi.

SOUTH AMERICAN POSITIONS—Mill Metallurgist for large copper concentrator, to work directly under Asst. Superintendent and be in full charge of all testing and research. Young Civil Engineering Graduate with some experience in maintenance of track and track equipment for Railroad Department. Assistant Railroad Superintendent for operation and maintenance of 44 miles of thirty-inch gauge main line track, diesel electric locomotives, etc. Smelter Superintendent, graduate Metallurgical or Chemical Engineer, with experience smelter operation and maintenance. Design or construction would be valuable. Assistant Chief Mechanical Engineer, experienced in shop practices, including supervision repair and production shops. Knowledge of iron, steel, and brass foundries, also field construction and installations. Graduate Mechanical Engineer with several years' experience in actual supervision of large shops comprising Machine Shops, Plate & Welding Shops, Iron, Steel and Brass Foundries. Large Copper Company Chile, South America. 3-year contract. Transportation both ways and salary while traveling paid by Company. Good opportunities. In reply give complete details. Address CA-4713, care of "Mechanical Engineering."

Additional Opportunities are offered in the display advertisements— on pages 46, 50, 56, 60, 62 and 128

POSITIONS WANTED

POWER PLANT ENGINEER—M.E. 20 years' broad power and mechanical experience—power, metallurgic, process plants—supervision, design, construction, maintenance, operation. Prefer varied engineering or supervision—small or industrial plant with power plant. Address CA-4694, care of "Mechanical Engineering."

MECHANICAL ENGINEER—M.S., P.E. (Ohio), 28, two years' automotive research, one year M.E. teaching, two years' Navy duty as torpedo project officer in charge of precision component production. Desires asst. professorship or industrial research-development position in Midwest with opportunity for advancement. Write Lt. Donald Powell, 545 Belleview Dr., Falls Church, Va.

MECHANICAL ENGINEER—8 years' research and development, organizational, and sales experience; construction and industrial. Have had responsible charge of developmental groups working in conjunction with production and manufacturing departments on mechanical, electronic, and hydraulic components and systems, new applications, processes, and techniques. Presently employed as sales and liaison engineer. Desire engineering position with greater opportunities and management responsibilities—U.S. or Foreign. Age 33, married, salary open. Address CA-4695, care of "Mechanical Engineering."

ENGINEER—B.S.I.E., 30, single, 2 years' experience maintenance and design, 4 years' field engineer for large industrial fire insurance company. Desire sales engineering or liaison. Enjoy travel, but want to limit trips to two weeks, as I'd like to settle down. Prefer southeast or southwest, will consider anywhere. Address CA-4696, care of "Mechanical Engineering."

MECHANICAL DESIGN ENGINEER—Stresses, strains, heat exchange, heavy machine design, special mechanisms; shop, construction and plant engineering experience; energetic and ambitious. Ohio and New York licences. Roger S. Williams, 11720 Edgewater Dr., Lakewood 7, Ohio.

GRADUATE MECHANICAL ENGINEER—37 years' old. Registered in Ill. 10 years' mfg. exp. in heavy industry. Supervisory exp. in mach. shop and welding dept. Good knowledge of business adm. Have good record for handling men without getting grievances. Desires responsible position leading to that of plant manager. Address CA-4706, care of "Mechanical Engineering."

MECHANICAL ENGINEER—31, BME, 2 years' Project Engineer on design and development. Desires position with small or medium size company requiring the services of a man with an engineering background. Work need not be of a technical nature. Address CA-4707, care of "Mechanical Engineering."

MECHANICAL ENGINEER—BSME, with 28 years' experience in all phases of industrial plant utilities work desires connection with expanding plant in operating or executive capacity. Excellent references. Address CA-4708, care of "Mechanical Engineering."

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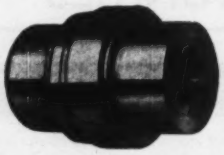

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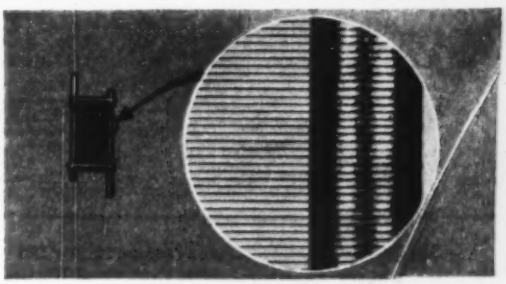

Grid is shown above left, actual size. Picture at right, enlarged 15 times, shows how wires are anchored by glass bond. They will not sag despite nearness of red-hot cathode.

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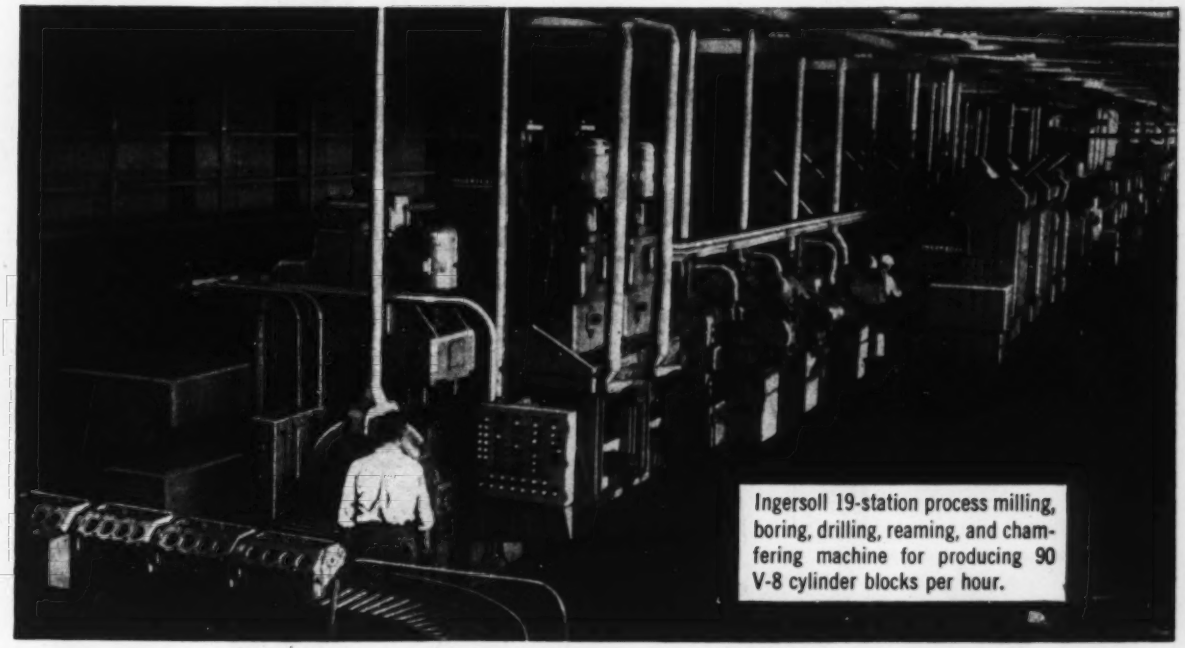

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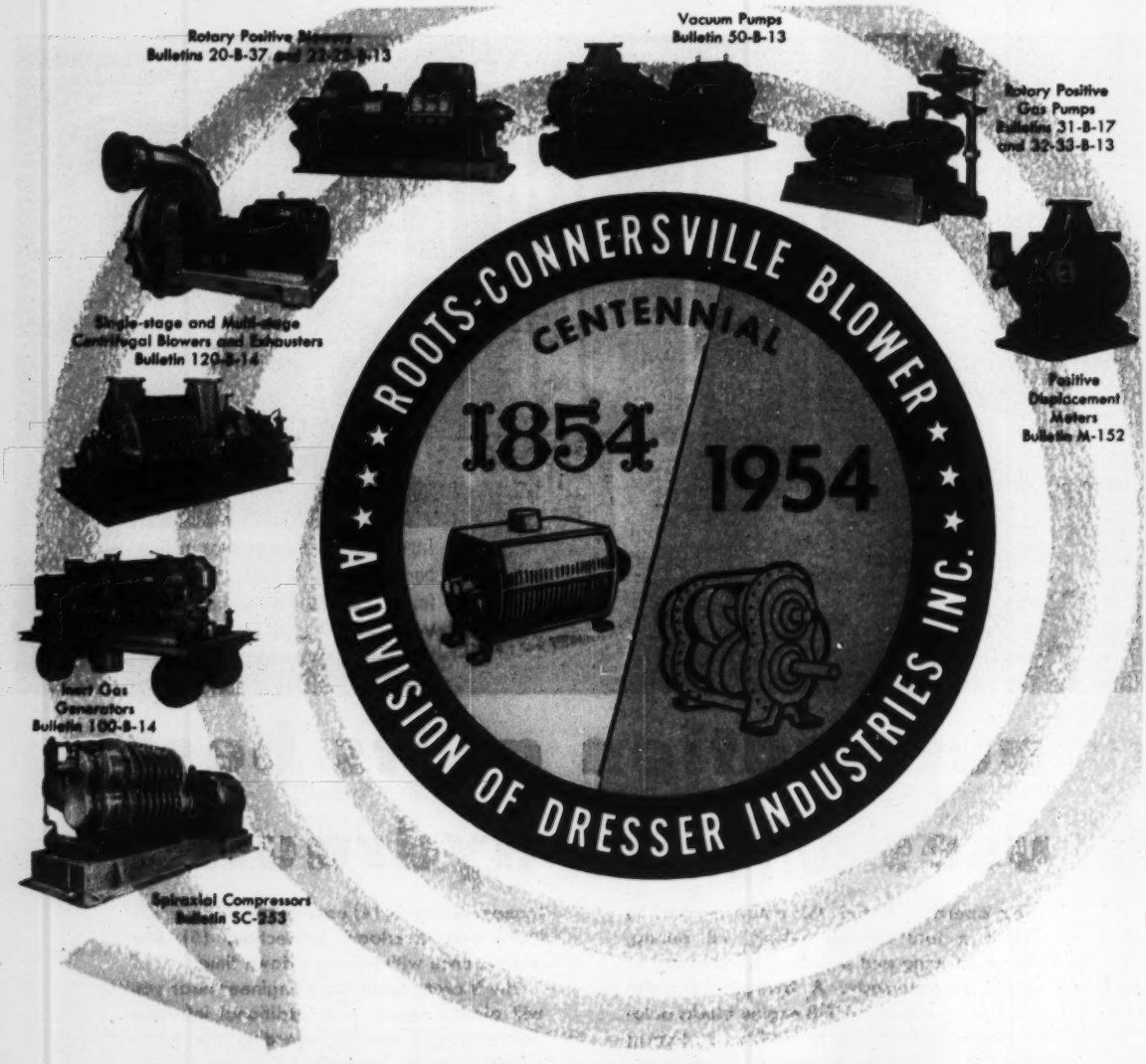

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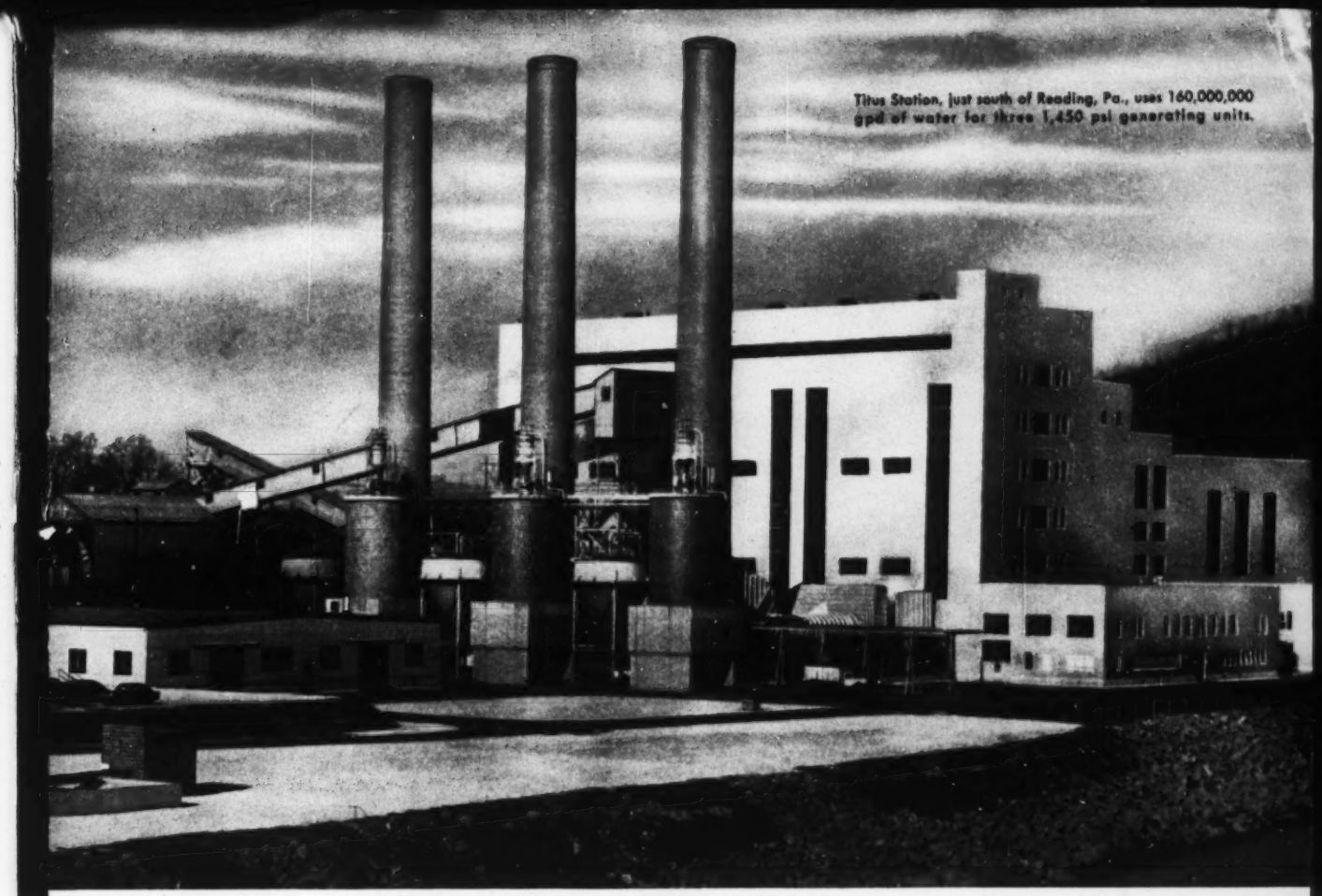

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METROPOLITAN EDISON BOOSTS CAPACITY BY 240,000 KW!

Latest $35,000,000 investment is protected by Permutit-conditioned water

Sheathed in aluminum—this silver giant is the last word in reliability and design.

Titus Station's output almost equals that of 5 other Metropolitan Edison Company stations. Permutit was selected to protect this important plant from untreated Schuylkill River water . . . turbidity of 700 ppm, hardness up to 180 ppm, high iron and manganese.

Two Permutit Precipitators remove trouble-making suspended solids, give clarified water for bearing cooling, oil coolers, etc. Part of this water goes on to Permutit filters and softeners . . . comes out crystal clear and completely softened for more critical uses.

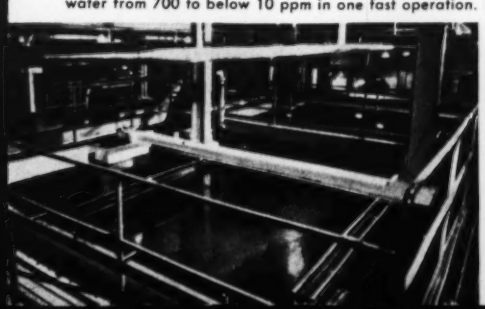
You can get this same protection for your plant. We will be glad to supply helpful information on your particular water problems. Write today.

The Permutit Company, Dept. ME-6, 330 West 42nd St., New York 36, N.Y., or Permutit Company of Canada, Ltd. 6975 Jeanne Mance Street, Montreal.

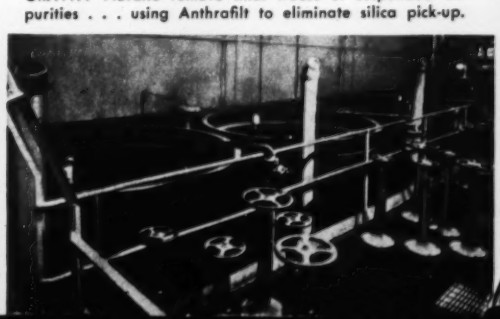
PERMUTIT®

Water Conditioning Headquarters for Over 40 Years

PRECIPITATORS reduce turbidity of Schuylkill River water from 700 to below 10 ppm in one fast operation.



GRAVITY FILTERS remove final traces of suspended impurities . . . using Anthrafilt to eliminate silica pick-up.



AUTOMATIC SOFTENERS deliver completely softened water. Regeneration is automatic . . . saves time and money.

AFTER 100 YEARS

...moving gas and air is still our ONLY business

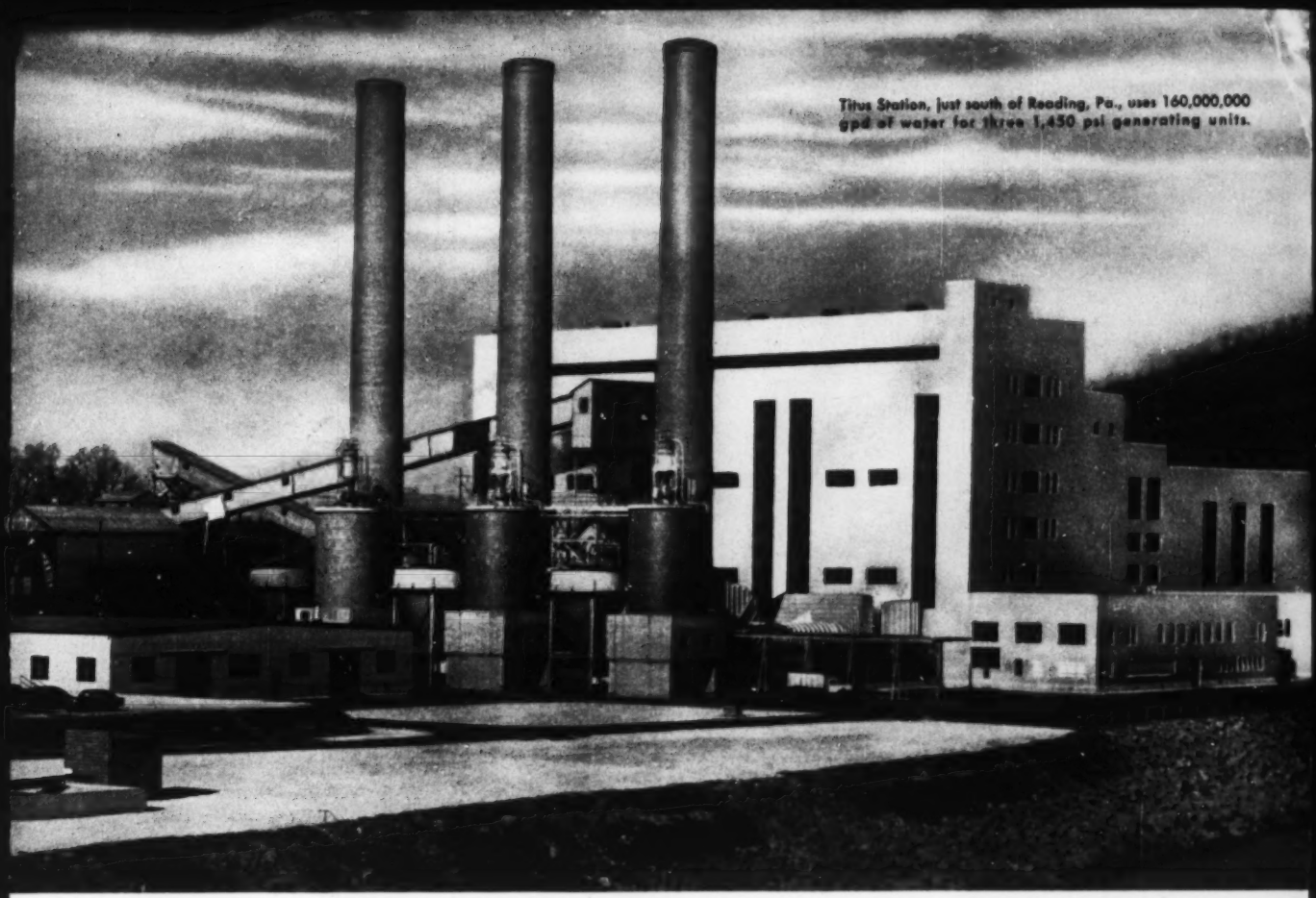
From the simple Rotary Positive Blower which we developed and started building 100 years ago, Roots-Connersville equipment now includes both Rotary Positive and Centrifugal units (the only *dual-ability* line in the industry), gas pumps, meters, vacuum pumps, inert gas generators and our latest 1953 development, the amazingly efficient Spiraxial Compressor. With the exception of the Spiraxial, the youngest members of the family are centrifugals, now 23 years old.

Yet in this century of rapid changes, with industries shifting from one product to another, Roots-Connersville has consistently adhered to one line of thought and action—the production of the most economical and reliable equipment to handle gas and air. We think this policy has "paid off"—not only to us but to our thousands of customers who, by their many repeat orders, testify to the high quality of R-C products. Perhaps one reason is that although old in years, we are young in ideas to meet technological changes in manufacturing processes.

So, we suggest you consult us when you are considering equipment to move gas or air. You will find that our 100 years of specialized experience can pay you substantial and continuing good dividends.

Reg. U.S. Pat. Off.

ROOTS-CONNERSVILLE BLOWER A DIVISION OF DRESSER INDUSTRIES, INC.
654 Michigan Ave. • Connersville, Indiana



Titus Station, just south of Reading, Pa., uses 160,000,000 gpd of water for three 1,450 psi generating units.

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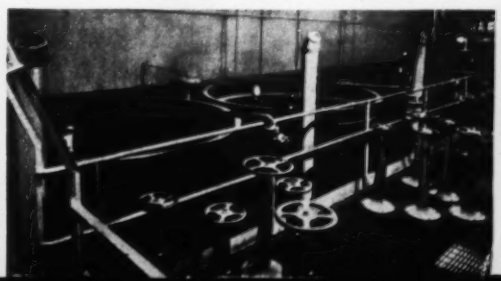

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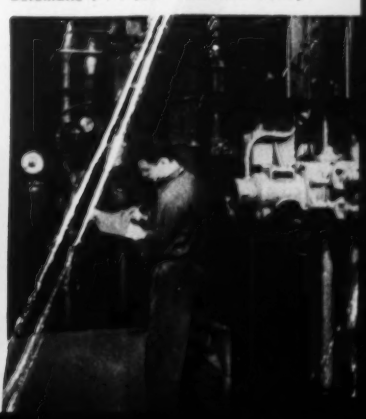


New Cleveland high speed automatic gets increased precision from TIMKEN® bearings in semi-flexible mounting

DESIGNED to be the "work horse" of many shops, this 2½" Model AW automatic, built by the Cleveland Automatic Machine Company, Cincinnati, Ohio, is not only precise, it's versatile as well.

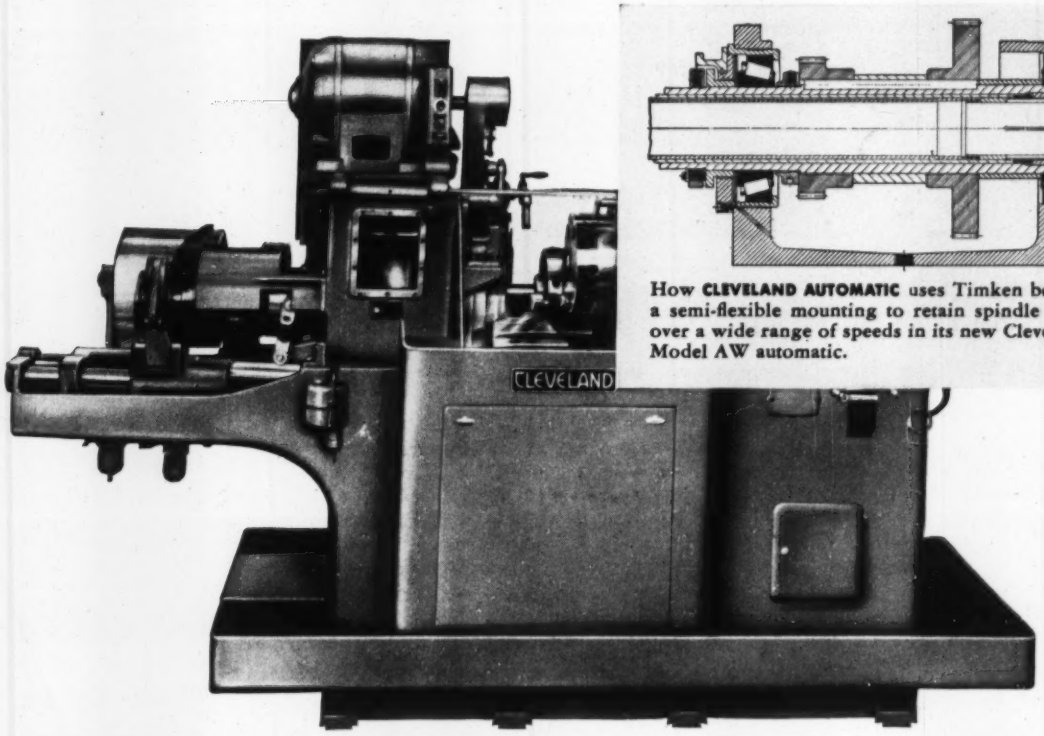
To accommodate its wide range of spindle speeds—40 in all—ranging from 69 to 1920 RPM, and to insure precision at any speed, Cleveland mounts the spindle on Timken® bearings in semi-flexible mounts. This permits any expansion during high speed operation without affecting accuracy.

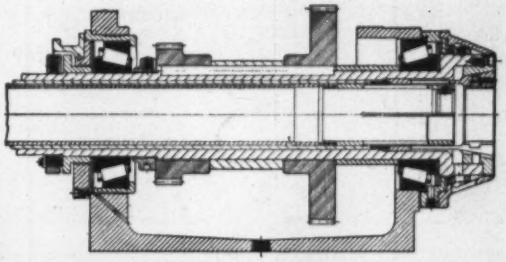
Timken tapered roller bearings hold shafts and spindles in rigid alignment. Line contact between rollers and races provides extra load-carrying capacity. Gears mesh smoothly with minimum wear under even the heaviest loads. Because of their tapered construction, Timken bearings carry radial and thrust loads in any combination.

The true rolling motion and incredibly smooth surface finish of Timken bearings practically eliminate friction. Shafts and housings are held concentric, making closures more effective.

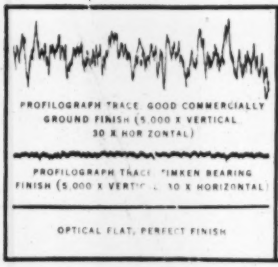
Be sure to specify Timken bearings when you build or buy machine tools. They normally last the life of the machine. Look for the trade-mark "Timken". The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.





How CLEVELAND AUTOMATIC uses Timken bearings in a semi-flexible mounting to retain spindle precision over a wide range of speeds in its new Cleveland 2½" Model AW automatic.


PROFILOGRAPH TRACE, GOOD COMMERCIALLY GROUND FINISH (5,000 X VERTICAL, 30 X HORIZONTAL)
PROFILOGRAPH TRACE, TIMKEN BEARING FINISH (5,000 X VERTICAL, 30 X HORIZONTAL)
OPTICAL FLAT, PERFECT FINISH

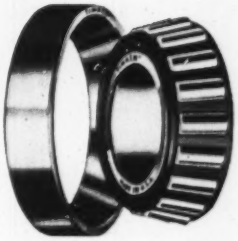
SMOOTH TO MILLIONTHS OF AN INCH

Surface finish of high quality Timken bearing rollers and races is so smooth that it takes a profilograph to measure its smoothness. This instrument measures surface variations to a millionth of an inch, as shown at the left.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ◯ NOT JUST A ROLLER ⬭ THE TIMKEN TAPERED ROLLER ⬭ BEARING TAKES RADIAL ⊕ AND THRUST →⊕← LOADS OR ANY COMBINATION →⊕←